PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

SEMI-MONTHLY

VOL. XXI. CHICAGO, APRIL 1, 1917 No. 7

The Canton Substation

AT AMERICAN GAS & ELECTRIC CO.'S CANTON SUBSTATION AN OUTDOOR SWITCHYARD REPRESENTS LATEST HIGH TENSION PRACTICE

AT THE CANTON END of the American Gas & Electric Co.'s transmission line, which was described in the Mar. 15 issue, is a 50,000-kv.a. substation of the semi-outdoor type. Here the transmission voltage is transformed from 130,000 down to 22,000 for local distribution, and every reasonable precaution is taken to secure the system against interruption for even short periods of time. An initial installation of 5 10,000-kv.a. transformers has been made with provision for almost unlimited extensions without in any way interfering with the continuous operation of the plant.

Before going into a detailed description of this substation, let us consider in a general way what the duties of the station are. Primarily, in this instance, the transformers are also important items requiring special machinery for handling.

Having the general problem before us we will take up more in detail a description of this substation, the engineering work of which was done by the Electric Bond & Share Co.

The site selected for the location is at the southern edge of the city, near the bank of a creek. It is connected by a spur to the main line of the W. & L. E. R. R. Being on a side hill considerable grading was necessary, but this was reduced to a minimum by so locating the plant that the earth taken from excavations was needed at other parts of the plant for filling in; the calculations worked so accurately that no long hauling was necessary.

In present day high tension systems, the spacing

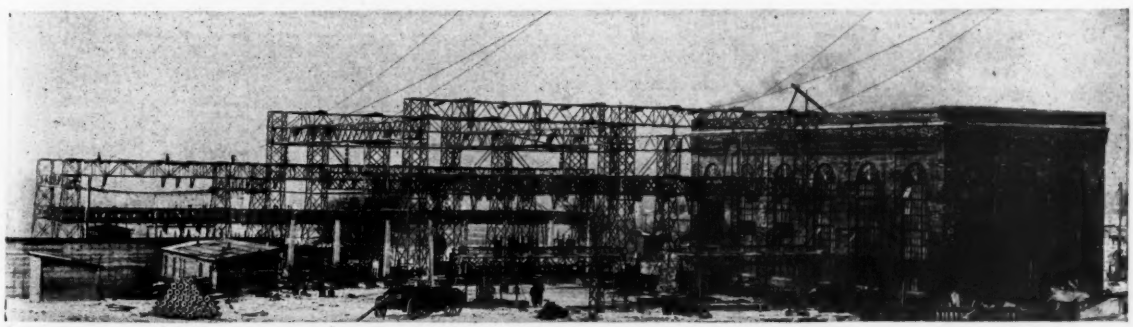


FIG. 1. GENERAL VIEW OF CANTON SUBSTATION LOOKING TOWARD 130-KV. YARD

object is to transform the voltage of the transmission line from 130,000 down to 22,000 for distribution in the vicinity of Canton, also to maintain a high power factor on the transmission lines. To protect station machinery from lightning surges, lightning arresters are employed. Oil switches and disconnects are necessary to control the course of the current. Bus bars are provided to facilitate connections to transformers, switches, etc. Transformers make the desired change in voltage. Synchronous condensers regulate power factor. High tension switches are operated by storage batteries and controlled from a station switchboard. Oil for transformers, switches and lightning arresters, and water for

required is so great that entirely indoor substations are practically prohibited because of building expense. But they are not necessary, as outdoor switches, lightning arresters and transformers have been designed for this service and with the control apparatus under cover a perfectly reliable arrangement is secured. The outdoor switch yard with a substation building housing control switchboards and other intricate machinery, as was provided in this plant, is recognized as the modern standard arrangement.

Figure 3 is a diagram of both high and low tension switchyard wiring. Only line No. 1, coming from Windsor, is shown; line No. 2 is similar except that the bus

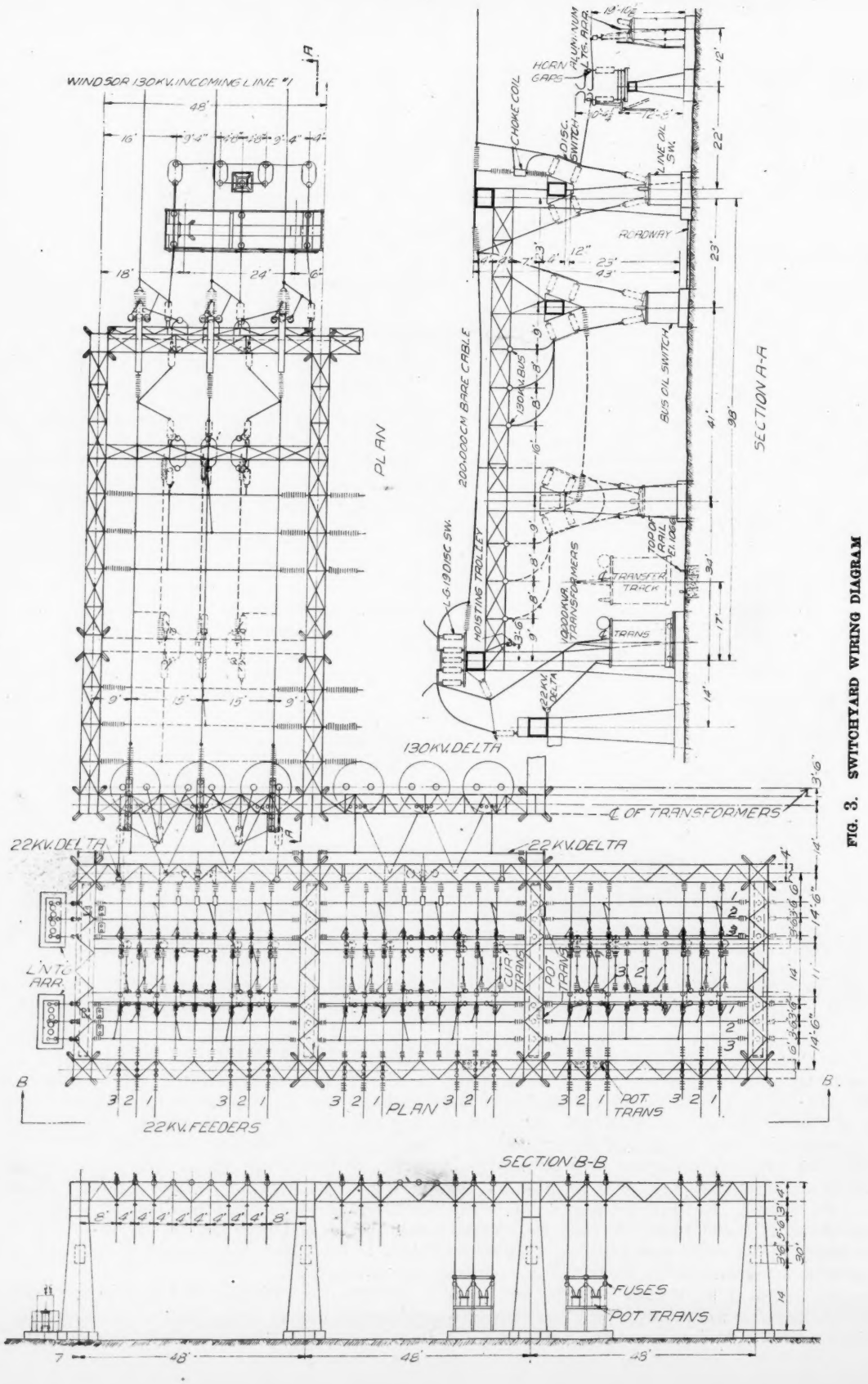


FIG. 3. SWITCHYARD WIRING DIAGRAM

oil switch is omitted. Current coming in from the right passes through choke coils and disconnect switches to the remote control line oil switches. Above the choke coils taps are taken off through disconnect switches to horn gaps and aluminum lightning arresters or through grounding devices. From the line oil switch the current passes through a disconnect switch up to the 200,000-c.m. cable which carries it across the bus structure to the Type LG-19 disconnect switch shown to the left, then to the transformers connected in delta; here the 22,000-v. circuits begin.

In order that current coming in on line No. 1 may be sent to the transformers in line No. 2, and vice versa, bus bars have been provided; these are connected

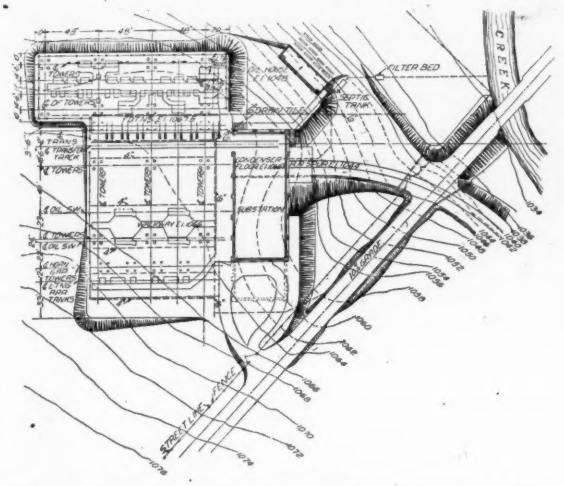


FIG. 2. FOUNDATION PLAN OF CANTON SUBSTATION SHOWING TOPOGRAPHY

through oil switches and disconnets to the cables above as indicated, the dotted lines represent connections provided for but not made as yet. As it is, continuity of service is doubly assured, but for safety's sake the engineers provided for the extra bus switch.

In the 22,000-v. yard similar precautions are observed to insure continuity of service. Current is supplied to 6 feeder circuits with provision made for indefinite extension as need demands. From each of the 22,000-v. deltas connection is made to 2 sets of bus bars through oil switches and disconnects; these feed the circuits, provision being made for connecting each feeder circuit to either set of bus bars. Instrument transformers are so located that current and voltage reading can be had for each circuit at any instant.

A clear understanding of the circuits may be had by a study of the outline wiring diagram Fig. 8. Here it will be noted that the main transformers are rated for 130,000 to 24,000 and 6600 v., the 6600-v. taps being used for operating the condensers and station machinery. Referring again to the 22,000-v. feeders, it will be noted that each circuit has 3 connections to the buses; 2 of

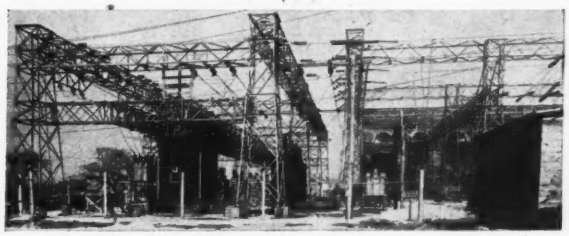


FIG. 4. TEMPORARY TRANSFORMER INSTALLATION

these are used interchangeably in regular service, being provided with circuit breaker and ammeter connections; the third, however, is used only in case the feeder switch becomes damaged, then all current is carried to bus No. 2, and bus tie switch 32 is closed, giving protection to the feeder, and current for the defective feeder circuit is taken from bus No. 1, other circuits being fed as usual from bus No. 2. The reliability of the system is apparent.

Substation Machinery

THE 6600-V. LINE leads directly into the building through underground conduit where the bus structures, switches, etc., are located. As previously stated, the condensers float on the line and regulate the power factor or probably speaking more correctly, they vary the power factor so as to maintain constant voltage on the secondary circuits.

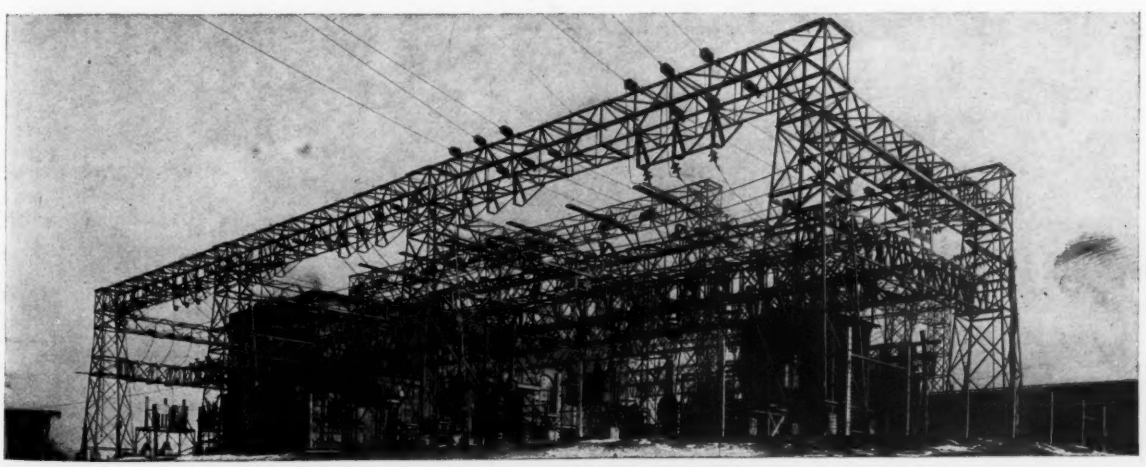


FIG. 5. 22,000-V. YARD UNDER CONSTRUCTION

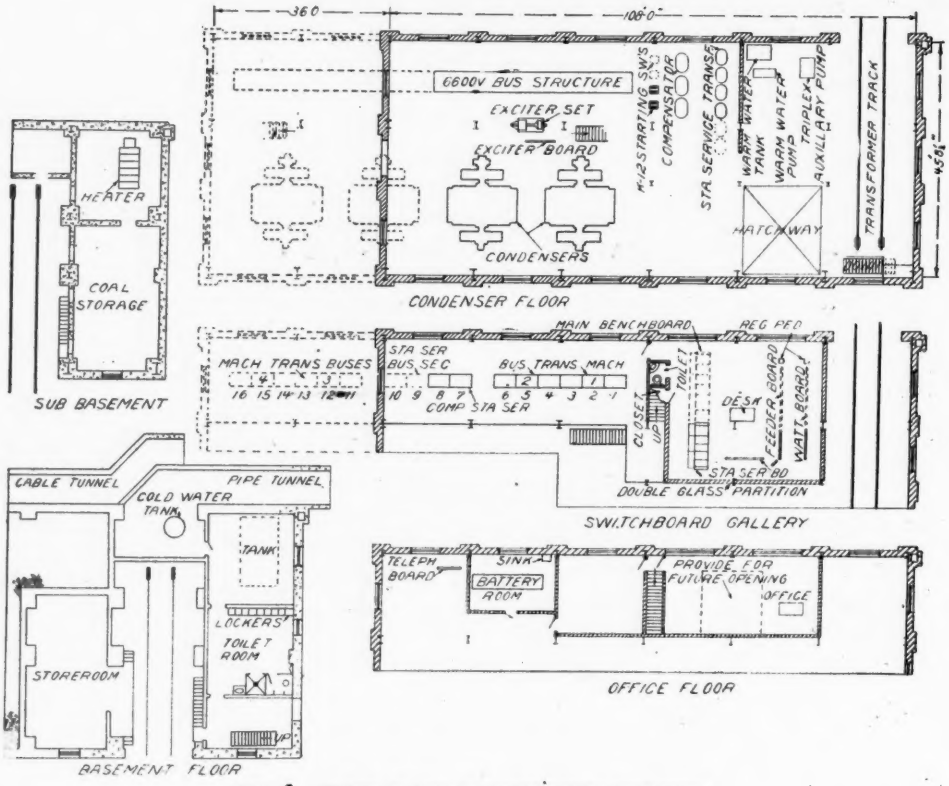


FIG. 6. FLOOR PLANS OF SUBSTATION BUILDING

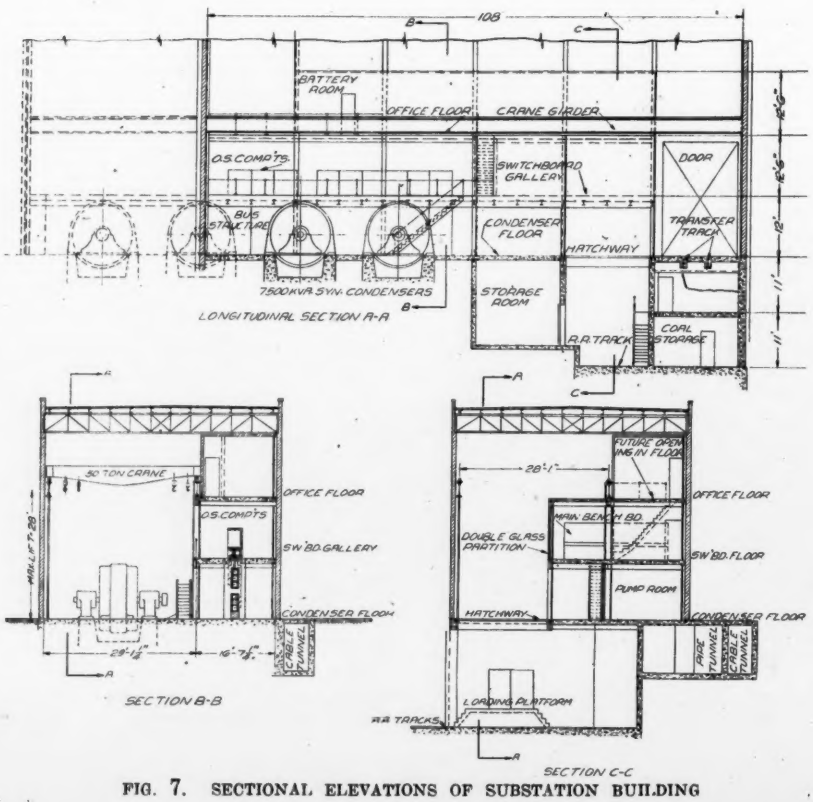


FIG. 7. SECTIONAL ELEVATIONS OF SUBSTATION BUILDING

Two condensers are installed, each having a capacity of 7500 kv.a., operating at 6600 v. The exciter in each case is direct connected to the condenser and has a capacity of 50 kw. developing 220 v. In addition, one exciter unit is installed for standby use, the driving element being an induction motor 220 v., 3-phase, 60 cycles.

Current coming to the 6600-v. main bus from either set of line transformers is conducted through 2 oil switches and 4 disconnects. Three starting compensators connect the main bus with the starting bus. Each machine is connected to both the main bus and the starting bus, but the switches are so interlocked that it is impossible to have both closed at the same time. For example, in starting condenser No. 1, switches 2 and 3 would be closed, also 8 and 20, with compensator in starting position. When the compensator is in the running position and the condenser up to speed, switch 20 is opened and 1 instantly closed and the machine is in service.

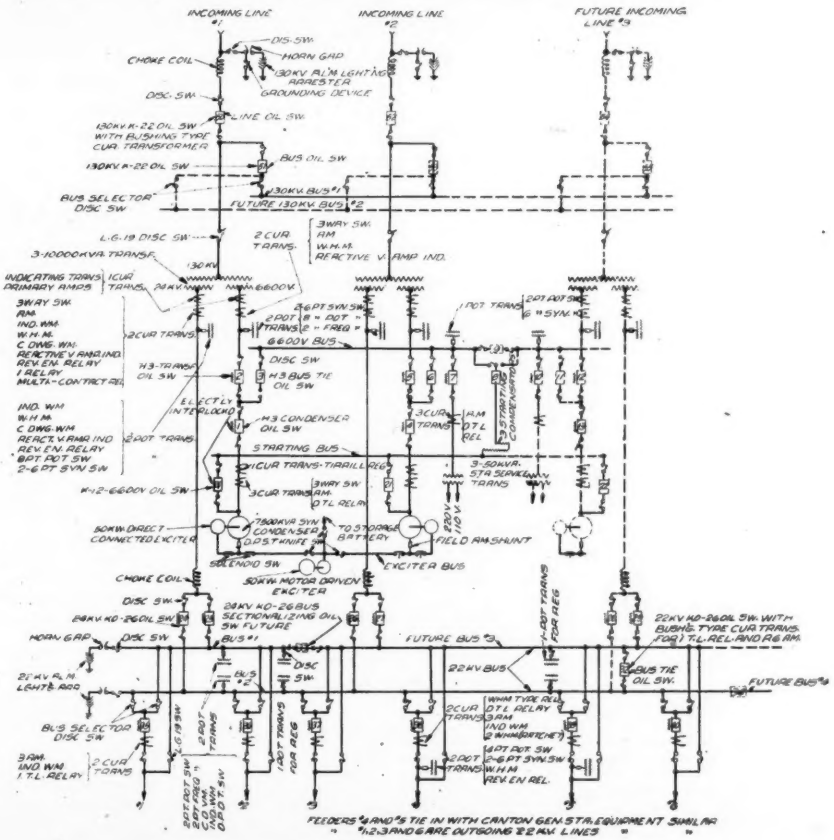

INCOMING LINE #1
INCOMING LINE #2
FUTURE INCOMING LINE #3
DIS. SW.
HORN GAP
CHOKE COIL
30 KV A.C.M. LIGHTNING ARRESTER
GROUNDING DEVICE
DISC. SW.
LINE OIL SW.
130 KV K-22 OIL SW WITH BUSHING TYPE CUR. TRANSFORMER
BUS OIL SW
130 KV K-22 OIL SW
130 KV. BUS #1
BUS SELECTOR DISC SW
FUTURE 130 KV. BUS #2
L.G.19 DISC SW
2 CUR. TRANS.
3 WAY SW. AM. W.H.M. REACTIVE V. AMP IND.
3-10000 KVA. TRANSF.
130 KV
INDICATING TRANS. PRIMARY AMPS
ICUR TRANS.
2400 V.
6600 V.
3 WAY SW. AM. IND. WM. W.H.M. C. DWG. WM. REACTIVE V. AMP IND. REV. EN. RELAY T. RELAY MULTI-CONTACT REL.
2 CUR TRANS.
2 POT TRANS
2 POT TRANS 2 - FREQ "
6 PT SYN SW.
1 POT. TRANS
2 POT POT SW. 6 " SYN. "
6600 V. BUS
DISC SW
H3 BUS TIE OIL SW
H3 TRANSF. OIL SW
ELECTRICALLY INTERLOCKED
IND. WM. W.H.M. C. DWG. WM. REACTIVE V. AMP IND. REV. EN. RELAY 6PT. POT. SW. 2-6 PT SYN SW
2 POT TRANS
H3 CONDENSER OIL SW
3 CUR TRANS
A.M. O.T.L. REL.
3 START. COMPENSATOR
STARTING BUS
3 CUR TRANS - TIRRILL REG.
3-50 KVA. STA SERVICE TRANS
W-H 2-6600 V OIL SW
3 CUR TRANS
3 WAY SW. AM. O.T.L. RELAY
50 KW. DIRECT CONNECTED EXCITER
7500 KVA SYN. CONDENSER D.P.S.T. KNIFE
TO STORAGE BATTERY
220 V. 110 V.
FIELD AM. SHUNT
EXCITER BUS
SOLENOID SW.
50 KW. MOTOR DRIVEN EXCITER
CHOKE COIL
DISC SW.
28 KV KO-26 BUS SECTIONALIZING OIL SW. FUTURE
28 KV KO-26 OIL SW
BUS #1
BUS #2
FUTURE BUS #3
1 POT TRANS FOR REG
22 KV KO-26 OIL SW. WITH BUSHING TYPE CUR. TRANS. FOR O.T.L. REL. AND A.M.
HORN GAP
22 KV A.M. LIGHTNING ARR.
22 KV BUS
BUS TIE OIL SW.
FUTURE BUS #4
BUS SELECTOR DISC SW
2 CUR TRANS
WHM TYPE REL. O.T.L. RELAY A.M. IND. WM (2 WHM UNITS IN ")
4 POT POT SW. 2-6 PT SYN SW.
W.H.M. REV. EN. REL.
3 A.M. IND. WM. I.T.L. RELAY
2 POT POT SW. 2 PT FREQ " C.O. WM. O.O.T. SW.
FEEDERS 4 AND 5 TIE IN WITH CANTON GEN. STA. EQUIPMENT SIMILAR
" #1-2-3 AND 6 ARE OUTGOING 22 KV. LINES " "

FIG. 8. WIRING DIAGRAM OF COMPLETE SUBSTATION

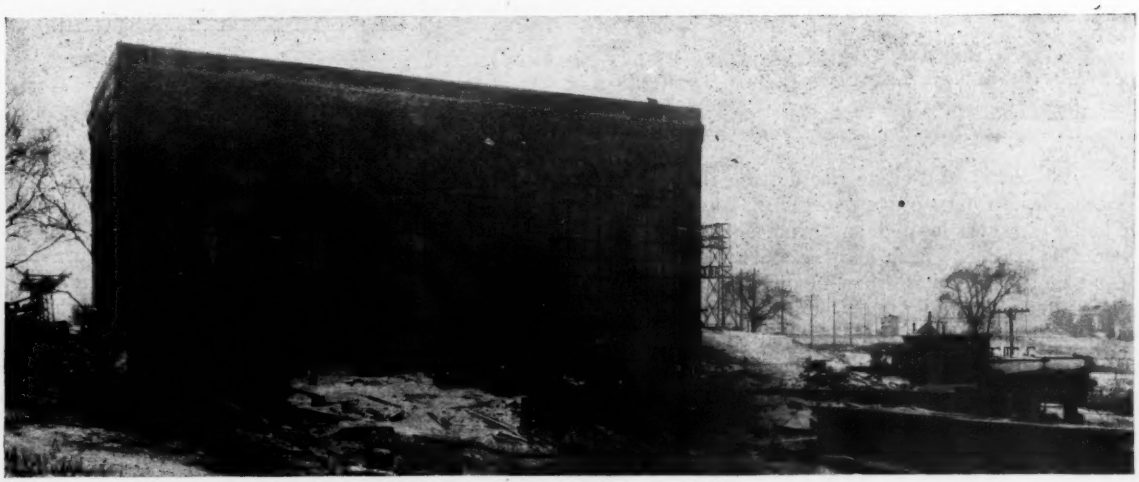


FIG. 9. LOW TENSION SWITCHING AND CONDENSER BUILDING WITH OIL HOUSE TO THE RIGHT

All of the switching of power circuits is done by remote control from the switchboard gallery where an elaborate switchboard and benchboard are installed. On the benchboard is a diagram of the circuits with signal lights showing the condition of circuits and position of switches. Current at 110 v. for operating the switches is obtained from a storage battery which is charged from a 9.65-kw. motor-generator set connected to the 220-v. a.c. circuit. Arrangement is also made for charging from the exciter bus of the condensers. Current for station lighting and auxiliary power is supplied by transformers connected to the 6600-v. bus, giving secondary voltage of 110 and 220. Three of these transformers are provided, each of 50 kv.a. capacity, one being a standby.

In arrangement of apparatus the plant presents a number of interesting features to which attention is called. Being located on the side of a hill the spur of railway enters the subbasement of the building. Above this is a hatchway and crane, facilitating the unloading of machinery. Coal storage and the station steam heating boiler are also located on this floor.

On the basement floor are the store room with unloading platform giving crane facilities, cable and pipe tunnel entrances, water tanks and locker rooms.

All the heavy machinery is located on the condenser floor, as is indicated in Fig. 6. The crane travels over all the condensers, hatchway and the end of the transformer track. The latter is provided for removing transformers from their locations in case repairs are necessary. The transformers are on wheels and tracks making them easily rolled onto a special truck which conveys them to the building. In a similar manner oil switches and lightning arresters may be removed to the substation building, but no rails are provided for transporting these, the truck for this purpose having flat wheels and running on a gravel walkway.

The main transformers are oil insulated and water cooled, the water passing through coils in the oil space of the transformer case. This water is obtained from wells 70 ft. deep, from which it is drawn by 2 American Well Works impeller pumps, driven by 35-hp. induction motors, and delivered to a cold water tank. City water connection is also provided for use in emergencies. A triplex pump forces the water through the transformer coils and back to the warm water tank. When a transformer is out of service, changes in atmospheric temperature would cause it to sweat if some provision were not made to maintain a temperature above that of the atmosphere; in this case, the water warmed by the transformers in service is pumped from the warm tank back through the coils of the idle transformers.

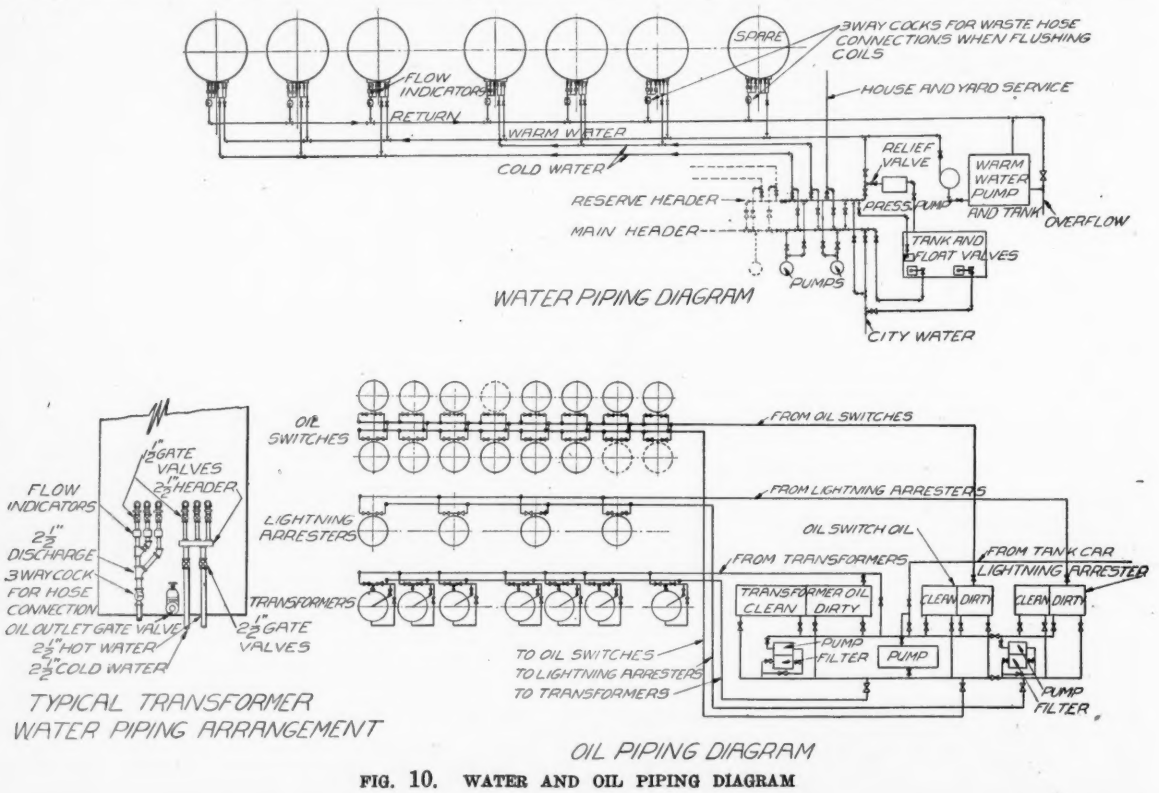


FIG. 10. WATER AND OIL PIPING DIAGRAM

Insulating oil for transformers, switches and lightning arresters is supplied from tanks in the oil house, a separate building housing the oil pumps, filters and one end of the oil tanks. In case repairs are needed to any of these machines, the old oil is drawn off to the dirty oil compartment of the oil tank from which it is run through a filter and pumped back into the clean compartment of the tank ready for use when needed.

Three tanks are installed, one having a capacity of 16,000 gal., the other 2, 7500 gal. each, and provision is made for one more tank.

Operating Conditions of Transformers

There are 2 high tension circuits, each line designed to carry part or the full 50,000 kv.a. load of the sub-

station, the voltage drop from power plant to substation being 10 per cent.

At present, only 5 transformers are installed, although the diagrams show the system laid out for 7. This, however, does not interfere with the operation of the system as the open delta connection is used at present. The reason for this arrangement is that as load increases one more transformer can be added to each bank, increasing the capacity 50 per cent, while if 3 transformers of proper capacity for the present load were installed originally, it would be necessary to replace those with 3 new larger transformers in order to increase the capacity.

Each transformer has a capacity of 10,000 kv.a.; at full capacity it will operate at a temperature of 176 deg. F. when supplied with 37½ gal. of water a minute at 77 deg. F. temperature. Water is taken from wells and some system for cooling will be provided when the well supply is insufficient.

Those in charge of the substation construction work are F. W. Abbott, vice-president and construction manager; Frank Howard, general superintendent; F. A. Pearson, construction engineer; P. O. Baker, construction superintendent for General Electric Co., and R. E. Behnke, engineer for Electric Bond & Share Co. The General Electric Co. furnished the electrical machinery.

Belting

Its Manufacture; Methods of Splicing

IN THE manufacture of leather belting, more skill and special knowledge is required than ordinarily realized by the average person. The purchase of the hides may to many appear as the first step in the making of the belt; but in order to warrant obtaining a good leather, it is necessary to consider the animal from which the hide was obtained, the season of the year when the animal was killed and the manner in which the hide was removed.

According to one of the largest manufacturers of leather belts, the hides from native steers killed in the short-haired season are unsurpassed, except when extra-heavy leather is desired. To meet this latter requirement, hides taken from extra-heavy Continental steers are imported.

Various processes are employed before the leather is ready to be made into belting. One manufacturer first stamps all hides to permit the tracing of any particular lot through the tannery, after which they are placed in vats of running water to clean them. The hair is then removed by placing the hides in a solution of lime water and scraping them with blunt instruments. Another bath follows to remove all possible accumulations of lime.

The hides are then placed across narrow sticks over receiving tanks where they remain until the pores of the leather are thoroughly opened.

Upon the removal of the hides from these receiving tanks, the belly portions are cut off and tanned separately for special purposes. The butt portions, those intended for belting, are laid flat in tanning vats, with a layer of bark between them, and are covered with oak tanning liquor. After being thoroughly tanned, the hides are taken from these vats, washed, skived to remove the flesh which may have remained on the hide during the tanning process, oiled and hung up to dry.

After thoroughly dried, all the poorer portions of leather are removed, the center, the best part for belting purposes, being retained. The trimming done, the belting portion is again washed and treated with grease to make it soft and pliable and then placed in a machine to flatten it. The hair or grain side is then given another finish known as glassing, which imparts to the belt its glossy appearance.

The strips are now cut into the proper width and matched so as to get those of a like relative thickness and quality into the same belt. The ends of these strips are then shaved down or scarfed, as it is known, in order to make the splice of uniform thickness, sized with glue, matched and placed under a hydraulic press, after which the edges are trimmed and the belt is ready for the market.

Canvas Belting

This is ordinarily made from cotton duck, although hemp and other fibrous materials are often employed. A 30 or 32-oz. duck is prepared by stretching and rolling, and the edges are then folded into the middle, thus giving 2 thicknesses of duck. For a 3-ply belt, a single thickness is cemented on top of the double belt while for a 4-ply belt, 2 double thicknesses are prepared and cemented together. In the best qualities, the plies are stitched as well as cemented, and the fabric is made from long-fibre, uncompressed cotton, especially hard woven.

This duck is treated with a special saturating material worked entirely through the fabric to soften it, preserve it and to give cohesion, the material used by different manufacturers varying according to their experience. Such belting is made in 3, 4, 6, 8 and 10-ply, the 4-ply, which is the most common thickness, being equal in strength to single leather belting, 6-ply to heavy single, 8-ply to double leather and 10-ply to heavy double leather.

Rubber Belting

Rubber belting is duck impregnated with rubber and partly vulcanized. Different weights of duck are used, according to the quality of belt made, but as a rule, 30-oz. material is used as the foundation. Building up the belt is much the same as for canvas, a 2-ply belt being made by folding the edges on the center and vulcanizing a strip of rubber along the joint, this joint being run always on the outside of the belt; 3-ply is made by folding a thickness of the friction inside the edges, the joint being covered with a strip of rubber while 4-ply is made by folding in the edges of 2 strips to the center and then cementing the folded strips together. A ply or layer is about 1/12 in. thick; but in calendering, or rolling down, and vulcanizing, the belt is somewhat compressed so that a 4-ply belt is reduced to about ¼ in. in thickness. Rubber belt of common construction will weigh about 12 to 15 lb. per ply per inch of width.

Balata

This is a belting with cotton canvas base impregnated thoroughly with balata, the milk of the Boela tree; the solution is forced into the meshes of the woven goods. Balata is not vulcanized as is rubber, but the material is thoroughly saturated with the dissolved gum and the outer surface is finally dressed with a thin coat to give the belt a finished appearance.

Joints

When an old belt requiring repairs can not, due to operating conditions, be removed from the pulleys, or when a new belt is installed and the matter of obtaining the correct length is of vital importance, it is practically impossible to close up a belt without the use of a tension clamp.

The most common form of this clamp, as shown in Fig. 1, consists of 2 strips of hard wood, of dimensions such as to give required stiffness and strength. These clamps, of which there are 2, are made to grip the belt by means of bolts passing through the ends of the strips; the tension is then taken up by rods joining these clamps, the rods being threaded for almost their entire length and provided with nuts by means of which the clamps are drawn together. The belt is now under tension, except the short section making up the joint. Work can, of course, not be done without some form of support under the pieces to be spliced, which, if the belt runs comparatively near the floor, may consist of a smooth board at least 1 in. longer and ½ in. wider than the joint, placed on a box, or boxes. Another method employed for holding this board and which is particularly valuable where the belt is at a considerable distance from the floor, consists of hanging it on the side

FIG. 1. COMMON FORM OF TENSION CLAMP USED WHEN SPLICING BELTS

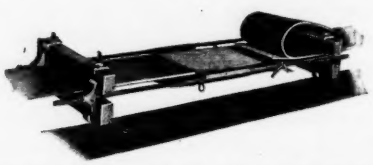


FIG. 2. TENSION CLAMP FITTED WITH SPLICING BOARD

rods of the clamps by means of hooks or by strapping it to the side rods in the manner shown in Fig. 2.

It is important that the rods joining the clamps be of sufficient length to take care of the longest possible splice and still give plenty of room to work.

In the case of a new belt, the ends should be cut perfectly square and scarfed with an even bevel for the required length. The belt is then clamped to the board in such a position that the 2 ends are brought into exact line; they are then tacked to the board back of the joint, the joint opened and served with a thin coating of glue, placed together and clamped by another board placed on top and heavy hand clamps. In order further to strengthen the joints, many mechanics, just previous to clamping, tack a row of wooden shoe pegs along the sides of the joint in a fashion similar to that employed by cobblers. The belt should then be allowed to stand in the clamps for 3 or 4 hr. and should not be placed under tension for at least 5 hr. after gluing.

The length of the splice on a double belt up to 10 in. wide should be 10 in.; on belts 10 to 18 in. wide, make the length of the splice equal to the width of the belt and all above 18 in., make 18 in. long.

In the case of single belts, the splice should be so arranged that the tip follows on the side next the pulley, the grain side being, of course, used against the pulley. On double belts, make the splice so that the tip follows on both sides of the belt, one end being scarfed as a wedge on the other end as a V.

All scarfing and scraping should be done by means of a scraper of the form shown in Fig. 3. This is made of a thin piece of steel (such as may be obtained from an old hand-saw blade) about 4 in. square and fixed in a hardwood handle by sawing about 2 or 3 in. into the handle and driving the blade in. The blade being firmly set, grind the edge rounding and with a taper of approximately ½ in. Hone it down first on a water or oil stone and then on a piece of leather until the edge is as sharp as that of a razor. Turn the edge by running it along one edge of a 3-cornered file, the teeth of which have carefully been ground off. This file should be securely fastened to the work bench by iron straps as shown in Fig. 4. During the first few strokes, let the handle bear on the file and as the edge turns, raise the handle gradually. The various steps employed in turning the edge of a scarfing tool are illustrated in Fig. 4.

The glue used for cementing the splice should be applied hot and may be made water-proof by adding a little bicromate of potash just before using. Remove all surplus glue from the brush and put the rest on the belt, making 2 or 3 fast strokes across the belt; close down the splice and by means of a smooth block of wood 2 by 6 by 8 in. rub as hard and fast as possible for about 2 or 3 min. Have an assistant raise the point until you see the glued joint just breaking, after which apply the second brushful in a like manner. Repeat this procedure until the entire joint is glued; then clamp the joint between the splicing board and a second board placed over the joint by means of hand clamps.

Many times, however, in order to repair a joint it must be opened. This requires somewhat greater skill and some special tools of the form shown in Figs. 5 and 6.

That shown in Fig. 5 may be made of a length of ½-in. round tool steel with the point spread out about 2 in. wide, well tempered and ground to a sharp edge. This edge must, however, be dulled on an oil or water stone so as to prevent cutting the leather. The handle, which should always be of substantial construction, may be made as follows: Place the tool in a lathe and for a distance of about 5 or 6 in. turn down to a diameter of ⅜ in.; obtain or turn up brass washer 1½ in. in diameter and ½ in. thick, and through the center of it bore a hole of such size as to be a driving fit on the

3/8-in. section of the tool; force the washer down to the shoulder thus formed.

From some scraps of leather, cut out a number of washers having an external diameter a trifle greater than the desired size of the handle, and with an internal diameter such that these washers will just pass over the turned section of the tool. In placing these washers, bind them by means of a coating of glue placed on both sides of each, with a steel retaining washer at the end. After the glue has sufficiently dried, place the tool in the lathe and turn down to the form shown in Fig. 5.

The second tool, which is considerably smaller than the other and used only to raise the thin edges the larger tool would have a tendency to tear, may readily be made from an ordinary heavy screwdriver with the point spread a trifle and rounded.

Let us assume that the splice shown in Fig. 7 is to be opened for the purpose of repair. Apply the tension clamps and take up on the side rods until the load is being carried by the clamps. Insert the larger ripping tool at B and gradually work it toward A; when the point is raised to A clear across the belt, open to C. After having opened the top side, proceed to open the middle in a like manner. With the belt entirely apart, take up on the side rods until the proper tension is obtained, throw the 2 ends of the belt back over the clamps and place the splicing board in position. Throw the 2 ends of the belt back on the board and lay off the scarfs by first taking a square and making the 2 thin

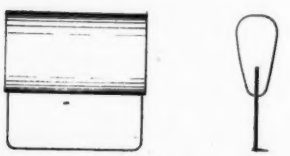


FIG. 3

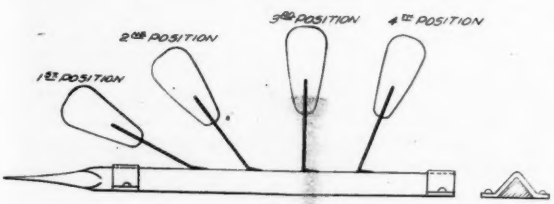


FIG. 4

FIG. 3. SCARFING TOOL

FIG. 4. METHOD OF TURNING EDGE OF SCARFING TOOL

points perfectly square and then placing the wedge end into the V end. Due to the tension having been taken up by the clamp, the wedge end will, of course, have to be cut off before the belt will lie down properly. With the point cut to the right length, take the square and mark the top of the wedge-shaped end, using the edge of the thin point as a measure of the length; then without moving the belt, mark the edge of the belt, showing just where the lower thin point of the wedge end came on the bottom of the V end. Throw the top of the V-shaped end over the left-hand clamp and scarf the top of the wedge-shaped end, making the scarf about 4 or 4½ in. long, taking care to keep the whole surface of this incline true and straight. By means of an old, dull scarfing tool, remove all the glue from C to D on the V-shaped end, after which turn this end over the right-hand clamp and with a scarfing board placed thereunder, scarf A C in a similar manner as E D. Remove all glue from C A of the wedge-shaped end and scrape until it fits C A of the V-shaped end. The top of the V-shaped end is now thrown back over the left-hand clamp and with a scarfing board placed thereunder, remove all glue from C D and scarf D E to fit the top of the

FIG. 5 FIG. 6

FIG. 7

FIG. 5. LARGE RIPPER FOR OPENING BELT SPLICES

FIG. 6. SMALL RIPPER MADE OUT OF AN OLD SCREW DRIVER BY SPREADING AND ROUNDING THE POINT

FIG. 7. SECTION OF TYPICAL BELT SPLICE

wedge-shaped end. This procedure requires considerable care and skill and in order to obtain a satisfactory joint, a good fit is of vital importance.

It may be advisable to state, at this point, not to do any scarfing on the splicing board, as in all probability it will become so gouged by the scraper as to render it unfit for any purpose.

A satisfactory fit having been obtained, glue the splice as directed above.

(To be continued.)

U. S. CIVIL SERVICE COMMISSION announces that from the examination for engineer, scheduled to be held beginning April 11, at the places marked "(E)" in section 2 of the Manual of Examinations for the spring of 1917, the following existing vacancies and future vacancies in the Indian Service requiring similar qualifications will be filled: One at Canton Asylum, S. Dak., $720; one at Riverside Boarding School, Kiowa Agency, Okla., $720; one at Navajo Indian School, Arizona, $600; one at Choctaw-Chickasaw Sanitorium, Okla., $840; one at Cheyenne and Arapahoe Indian School, Okla., $720; one at Jicarilla School, N. Mex., $780. To be eligible for appointment to these specific positions, applicants must be without dependents, and must qualify in steam and electrical engineering. Requirements for the examination are contained in section 139 of the Spring Manual. Apply for Form 304 and a copy of the Spring Manual, to the Civil Service Commission, Washington, D. C.

Coal and Ashes Handling and Storage--IV

LOCOMOTIVE CRANES GIVE FLEXIBILITY FOR LARGE OR SMALL STORAGE PLANTS IN DISTRIBUTING TO RESERVE STORAGE AND RECLAIMING. BY HENRY J. EDSALL

IN FIG. 8 IS SHOWN the plant of the Victor Talking Machine Co., Camden, N. J. At this plant coal is unloaded from boats by means of a locomotive crane operating on a trestle and equipped with a clam shell bucket, which deposits the coal in a weighing car or larry operating on the same track and then pushes the car either to the track hopper where the coal is fed to the conveyor equipment, or delivers it to the outside storage. The crane also distributes the coal over a larger area along the trestle so as to give a total storage of about 7000 tons, and when this coal is wanted it is picked up by the clam shell bucket and again transferred by the weighing car.

From the track hopper, the coal is fed by means of a reciprocating feeder to a crusher and then goes to an inclined pivoted bucket carrier which, at the head end, delivers to another pivoted bucket carrier that distributes the coal in the overhead bin. The capacity of the bin is 800 tons, and underneath it there is a 1-ton motor-operated weighing hopper, Fig. 9, for delivering to the Taylor stokers. Eventually there are to be twelve 500-hp. boilers, so that the daily coal consumption may run up to 200 tons, which would mean that the overhead bin supply would last about 4 days. Ashes are handled in cars underneath the ashes hoppers, and a skip hoist and overhead ashes bin are to be built later on.

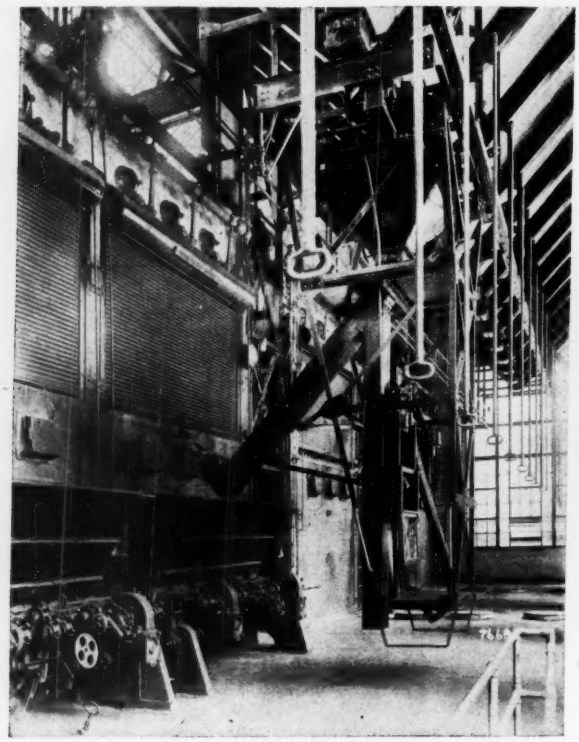


FIG. 9. 1-TON TRAVELING WEIGH HOPPER FOR SUPPLYING STOKERS

DISTRIBUTING BY WEIGH HOPPER

IN FIG. 10 is shown the plant of the Counties Gas & Electric Co., at Norristown, Pa. The track comes in on a trestle about 20 ft. above the boiler-room floor level and the coal is dumped into a large concrete track hopper. From the track hopper the coal is fed to a 2-roll crusher and then goes to a double strand coal elevator which delivers it, by means of chutes, to a 300-ton overhead suspended bin at one end of the boiler room. For transferring the coal to the stokers, a 2-ton motor-operated weighing hopper is used, traveling on tracks supported on the boiler columns and on other columns out in front of the boilers. Type E stokers are used at this plant, built by the Combustion Engineering Corporation.

As there is no basement in this boiler room, ashes are raked out onto the floor and delivered through gratings to a drag chain conveyor running along in a trench; this conveyor delivering to an inclined machine of the same type which deposits the ashes in a pit, from which they are removed by a clam shell bucket operated by a locomotive crane. The drag chain conveyors consist of a single strand of 12 in. wide block type chain sliding along in a hard white iron trough. The ashes are pushed along the trough by the chain itself, as there are no flights or other attachments. This type of ashes conveyor has proved very successful in many cases, for while the chains, wheels and trough do wear out after a certain length of time, yet the conveyor is simple and the parts just mentioned are about the only ones that wear, so that even with this replacement at stated intervals the cost of upkeep is not excessive. There is also an outside reserve storage at this plant, the coal being dumped underneath a trestle and distributed and re-

FIG. 11. LOCOMOTIVE CRANES, CABLE RAILWAY AND BOAT UNLOADERS FOR LARGE STORAGE PLANT

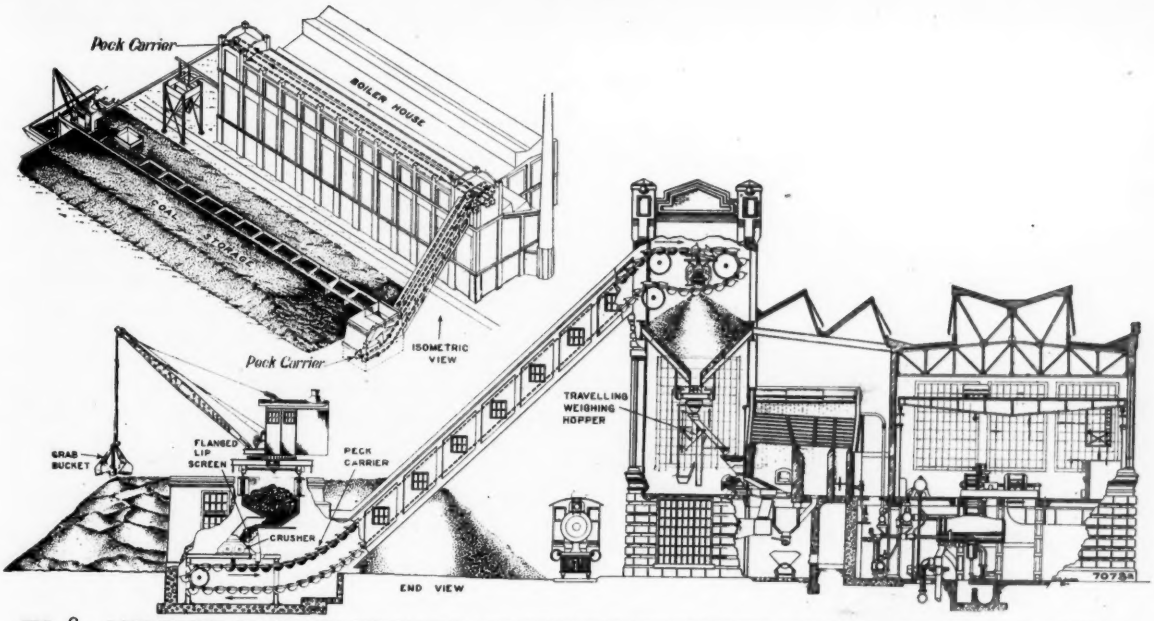


FIG. 8. LOCOMOTIVE CRANE FOR UNLOADING AND STORAGE HANDLING WITH INCLINED AND CROSSOVER BUCKET CONVEYOR TO BOILER HOUSE

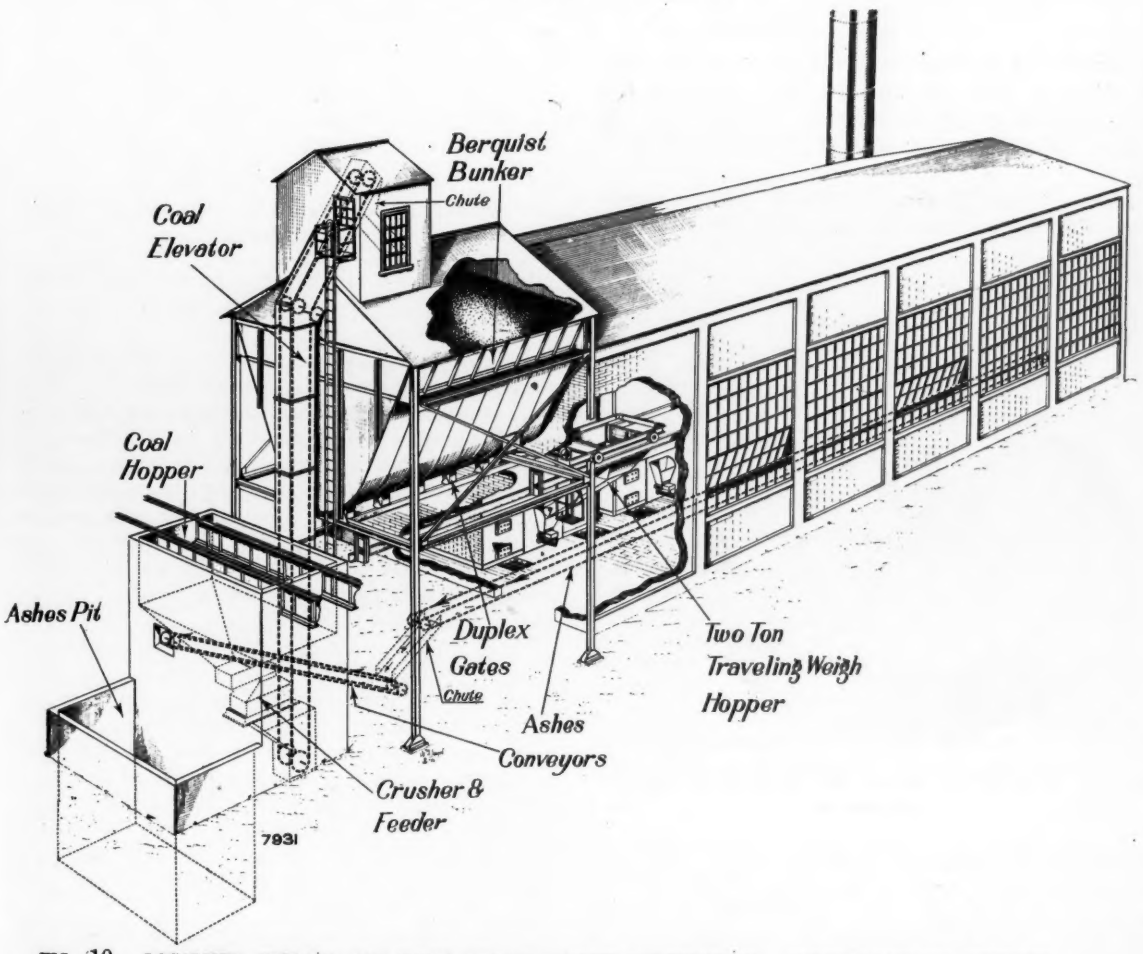


FIG. 10. LOCALIZED STORAGE BIN WITH WEIGH HOPPER DISTRIBUTION. ASHES HANDLING WITHOUT BASEMENT HOPPERS BY DRAG CHAIN

claimed by the locomotive crane equipped with a clam shell bucket.

Figure 11 shows the large storage plant of the New York Edison Co., at Shady Side, N. J., across from New York City. This plant has 2 100-ft. radius locomotive cranes with 3½-ton buckets and a cable railway

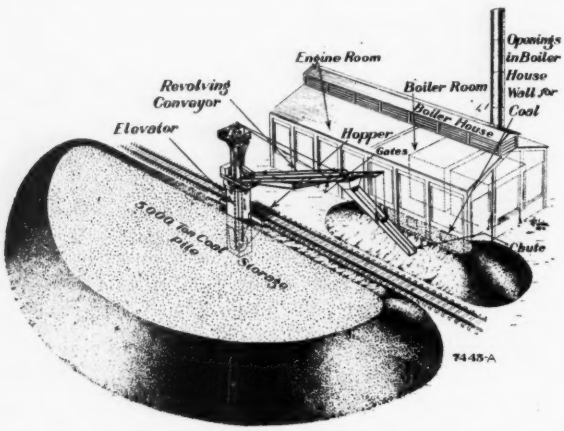


FIG. 12. ROTATING BUCKET ELEVATOR AND FLIGHT CONVEYOR FOR 5000-TON STORAGE

for distributing the coal along the length of the plant and taking it back. It also has both unloading and loading machinery for transferring the coal from and to boats. The storage capacity of this plant is 225,000 tons.

Figures 12 and 13 show 2 types of 5000-ton storage plants, the first using a coal elevator fed from a track

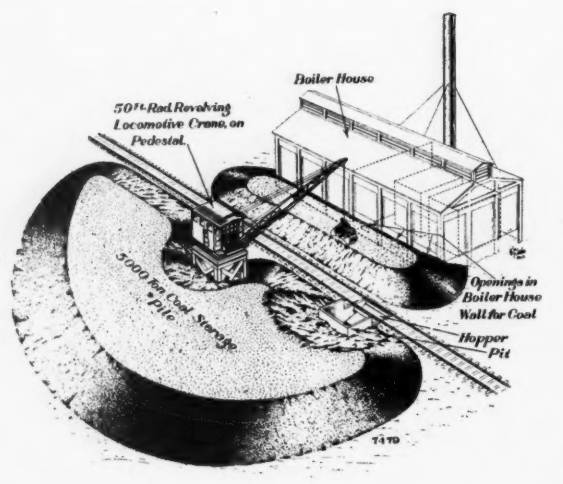
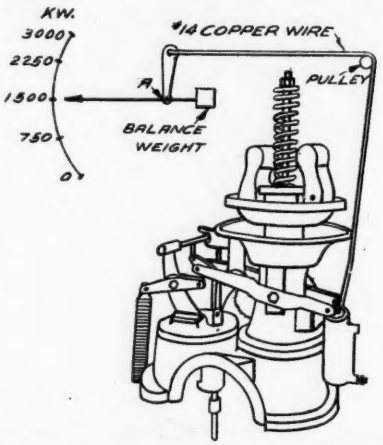

Boiler House
50'-0 Rad. Revolving Locomotive Crane, on Pedestal
5000 Ton Coal Storage Pile
Openings in Boiler House Wall for Coal
Hopper Pit
7470

FIG. 13. LOCOMOTIVE CRANE FOR RESERVE STORAGE AND RECLAIMING

hopper and delivering to a rotating conveyor; the second using a locomotive crane on an elevated pedestal which picks up the coal with a clam shell bucket from a pit into which it is dumped from the railroad cars. The former equipment is the cheaper of the two, but cannot reclaim the coal as can the locomotive crane.

An Ingenious Load Indicator

SINCE the publication of the description of the power station of The Massillon Electric and Gas Co., of Massillon, O., in the Aug. 1, 1915, issue of this magazine, R. V. Wynne, superintendent of that company, informs us of the addition of 3800 kw. to their regular light and power load. This load, which varies from 100 kw. to the above-mentioned figure within exceedingly short intervals of time, was found to be the cause of considerable trouble in the boiler room, as, due to the sudden load changes, the firemen were unable to control the performance of the boilers. While at one moment, they would be "popping off," a few minutes after would find the firemen hard at work trying to bring up the steam pressure. This variation



LOAD INDICATOR LOCATED IN BOILER ROOM OPERATED BY TURBINE GOVERNOR

of load was hard to control, considering the capacity of the boilers being but 1958 hp. and hand firing employed.

Relative to the manner in which considerable of this trouble was overcome, Mr. Wynne states: "I believed if we had some form of indicating device which would show the firemen the approximate load on the turbines, we would be able to operate much better, so I had the scheme shown in the accompanying illustration installed. We attached a hook to the governor arm just above the dashpot, to which, in turn, was connected a length of No. 14 copper wire, the opposite end of which was attached to a large dial located in front of the boilers and in plain view of the firemen.

This pointer is about 6 ft. long and moves through an arc of approximately 8 ft. in length. As the load comes on, the governor arm lowers, and through the medium of the copper wire which extends from the turbine governor into the firing aisle, causes the pointer to rise, the amount of which depends, of course, upon the position of the governor. For a given load, the governor arm will always be in about the position so that the scale on the indicator has been calibrated in kilowatts, thus informing the firemen of the approximate value of the load.

"This device cost us about $3 to install and the many engineers who have seen it work, speak of it in the highest terms."

Water Heating in Closed Tanks

METHODS OF USING STEAM DIRECT IN TANKS. BY T. W. MURPHY

HEATING water in closed tanks is accomplished either by passing steam through coiled pipes, in which case the steam does not come into direct contact with the water and the condensed steam is not only wasted, but must be trapped off, or by admitting steam directly to the water through perforated pipes, in which method the steam, on coming into contact with

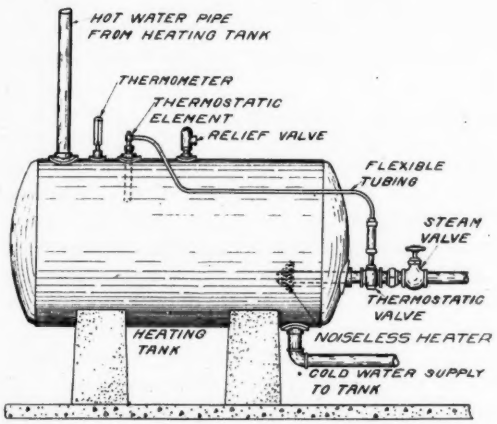


FIG. 1. NOISELESS HEATER INSTALLED IN TANK

the cold water causes an objectionable cracking noise and also jarring and vibration, which loosens joints and breaks fittings in the piping system. The installation to which this article refers was that of heating water in a 1000 gal. storage tank from 40 to 140 deg. This water was used for wash basins, showers, etc. The supply water entered the tank under 40-lb. pressure, from the street main, and live steam of 120-lb. pressure was used for heating this water. In the first installation a continuous water heater was used. This heater works on the jet principle. The 40-lb. city pressure water was passed through the heater and the discharge from the heater was piped directly to the storage tank, but proved unsatisfactory, because of the fact that a heater of this type must have a free discharge, which was not the case when all the faucets were closed.

Several installations of the above character have been made, but were replaced by noiseless water heaters, as illustrated in drawings. The result after the noiseless heater was installed was that the vibration and jarring were entirely eliminated, and the cracking noise was changed to a low buzzing sound, which was not objectionable.

This noiseless water heater discharges in the form of an inverted cone, offering a large surface and thus causes rapid condensation and circulation, and will heat water in closed tanks without noise or vibration up to 170 deg. F.; above this temperature the metallic buzzing increases slightly in proportion to the increase in temperature, but in most cases is not found objectionable.

The noise varies with the pressure in the closed tank —the higher the pressure the louder the buzz, but in no case does the cracking noise exist which accompanies all cases of admitting steam directly to water, through perforated pipes.

In cases where the heating tank is not yet constructed, or for tanks which will admit of inserting the noiseless heater, the installation is made as shown in Fig. 1, which is self-explanatory.

In cases where the heating tank exists, however, or is of galvanized material, which will not admit of having a hole cut in, on account of the galvanic action which would be set up, then the installation is made according to Fig. 2. In this latter case, an auxiliary tank is used, the heater being installed therein while the thermostatic element is inserted in the storage tank, as this is the place where constant temperature is to be maintained.

This installation has been found satisfactory, inasmuch as the smaller heating tank can be placed in the engine or boiler room where space is valuable, while

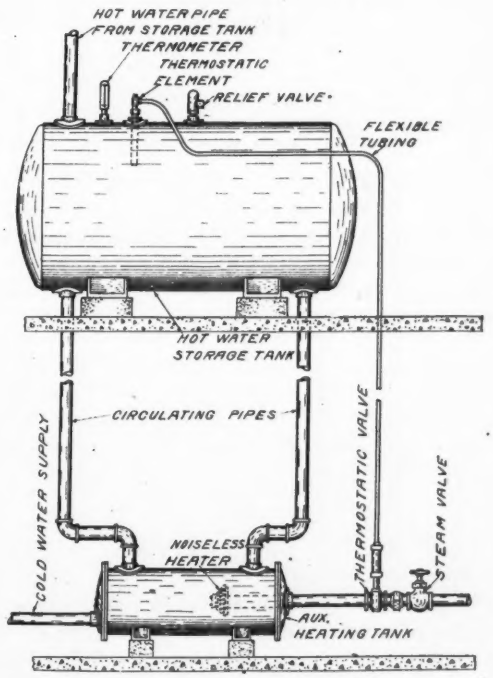


FIG. 2. HEATER IN AUXILIARY TANK

the storage tank can be placed where space is less valuable.

Heating water for wash-room purposes by direct contact of steam and water has proven an advantage, as the water is somewhat softened by the condensed steam.

NUTS WHICH JARRED loose on a grinding machine were made to "freeze" tight by using cold rolled steel for the bolts and casehardening the nuts which were made a snug fit. This, as explained by J. B. Murphy in Machinery, gave a tight and permanent connection without undue screwing up of the nuts.

American Institute of Weights and Measures

REVIVAL of the agitation for the adoption of the metric system after a dozen years of quiescence makes necessary a renewal of measures for the preservation of established standards. The voluminous literature which was the outgrowth of the last agitation is a mine of information; but, with the passage of time, it has ceased to be readily accessible. In that literature it was demonstrated that the complete adoption of the system is impossible, the only possible result of the attempt being a partial adoption. Such partial adoption or continued use of two systems side by side leads to a complete nullification, and reversal of metric claims (all of which are based on the assumption that the change is to be complete) and results in a state of confusion which is common in so-called metric countries and scarcely capable of description.

It is to the manufacturer especially that this condition is serious. Standardized portions of his products cannot be changed, while many others can be, and the making of some parts of a machine, even of some dimensions of single pieces, to one system and of others to another would result in a degree of confusion and disorder that can be imagined better than described. Examples of this practice are common in metric countries.

It is probably in the use of the metric system in engineering combined with manufacturing that the case is at its worst. All engineering construction makes use of the standardized manufactured things through the application of engineering formulas and tables. If the engineer is to use the metric system in connection with such standardized articles of manufacture, our vast volume of engineering literature has no application and must be rewritten from the beginning to suit this condition. That is to say, the change involves either the sacrifice of existing standards to save the literature or the sacrifice of existing literature to save the standards. As a matter of physical fact, the standards cannot be changed and the literature will have to go, the final result being a hybrid system of English standards and metric applications.

In most discussions of the subject the commercial application of weight and measure—the buying and selling of commodities—is the only one considered and many advocates of the metric system fail to realize that there is any other. It is when the industrial and technical applications are considered that the danger of the compulsory introduction of the metric system looms largest.

Following their overwhelming victory of a dozen years ago, the opponents of the metric system went to sleep. Not so, however, with the metric party who have continued their publication of assumptions and statements while the public, to whom the extended investigations necessary to refute these statements are impossible, has been misled.

Last spring came a remarkable report of Dr. Stratton, director of the National Bureau of Standards, on the metric system in export trade and with it the realization that he had at his command the use of the Government printing office at Washington for printing and of the facilities of the Post Office Department for distributing his literature—both without cost. Almost simultaneously came the knowledge of the annual conference of weights and measures officials, through which metric doctrines are distributed throughout the country.

Following these disclosures, the opposition awoke under the leadership of Henry D. Sharpe. Several meetings were held with the result that the organization of a defense association was decided upon. This has been organized as the American Institute of Weights and Measures.

The objects of the new Institute are declared to be:

The maintenance and improvement of our present (English) system of weights and measures, for the good of our commerce and industry and the well-being of our country.

The education of the people with respect to the importance of our weights and measures, through the dissemination of correct information with respect to them and to the danger in changes of our basic standards of measurement.

The improvement of old and the development of additional standards as they may be needed by reason of new conditions in commerce, industry, science and engineering.

The promotion of wise legislation for the conservation of our basic English units of weight and measure and opposition to hasty and ill-considered legislation involving changes from our fundamental English standards.

There are three grades of membership: Association, Corporation and Individual.

The annual dues of Association members are $100 for associations which are national in scope and $25 for all others. The annual dues of Corporation members employing less than 500 employes are $25, and of those employing more than 500 and less than 1000 employes, $50; then increase at the rate of $25 for each additional thousand employes or fraction thereof, up to a maximum of $500. The annual dues of Individual members are $5.

At a meeting of the Council at the Engineers' Club, New York, Feb. 19, the following officers were elected:

President, W. R. Ingalls; vice-presidents, Henry D. Sharpe and D. H. Kelly; treasurer, Walter M. McFarland; commissioner and secretary, F. A. Halsey.

The Institute will open offices in New York at once and will inaugurate an aggressive campaign. Applications for membership should be sent to F. A. Halsey, Commissioner, Hill Bldg., 10th Ave. and 36th St., New York.

U. S. CIVIL SERVICE COMMISSION announces an examination for mineral examiner, on April 4. Several vacancies in the General Land Office for duty in the field, at entrance salaries ranging from $1320 to $1500, and future vacancies requiring similar qualifications for duty in the field and in Washington, D. C., will be filled from this examination. Duties require an expert knowledge of geology, mineralogy, practical mining, and the land laws concerning mining claims on the public domain. Applicants must have reached their twenty-first birthday on the date of the examination. Apply for Form 1312.

Coal Storage De Luxe

COMPACT SYSTEM PROVIDED FOR LARGE PUMPING STATION

SITUATED as it is, in a popular residential district, with a large municipal bathing beach on one side and a hospital on another, it was highly desirable that the coal for the Lake View Pumping Station of Chicago be stored compactly and inconspicuously.

To eliminate the unsightly coal pile, a building 30 by 160 ft. was erected at right angles to the boiler house with reinforced concrete construction and faced with red brick to provide a pleasing exterior that harmonizes with the surroundings. In addition to the crushing equipment, this building contains 13 storage hoppers which have a combined capacity of approximately 3000 tons. One section of the building is shown in Fig. 1.

Coal is delivered to the station by automobile trucks and dumped through hydraulically operated trap-doors into a weighing hopper under the driveway. It is then delivered by a 30-in. apron conveyor to a 4-roll crusher which is driven by a 20-hp. motor.

To facilitate the securing of laboratory samples for

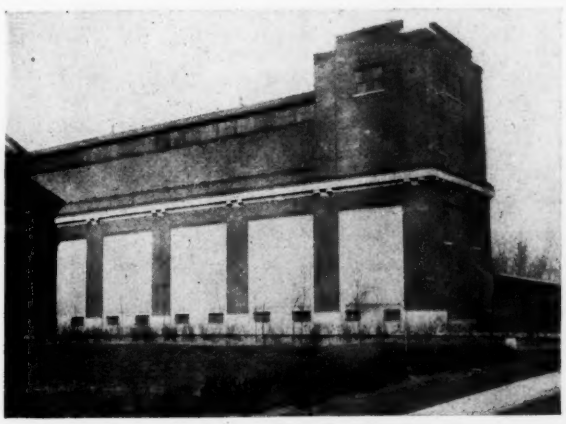


FIG. 1. EXTERIOR OF COAL STORAGE BUILDING

testing purposes, a coal sampling apparatus is located in the crusher pit, which takes a portion of the coal discharged from the crusher and elevates it by means of a small bucket conveyor to a grinder which is operated by a chain drive from the crusher. After passing through the grinder, the coal is subdivided, a part of it entering the sample container, while the balance is dropped to the conveyor.

Provision is made at the crusher to discharge the coal into the conveyor leading to the storage hoppers or into the conveyor which serves the boiler room hoppers, an automatic spraying arrangement wetting the coal as it leaves the crusher. Each conveyor, of the pivoted bucket type, is operated by a 15-hp. motor, and made up of 18 by 24-in. buckets, the storage house conveyor being approximately 550 ft. in length, with 272 buckets while the boiler house conveyor with 252 buckets is about 500 ft. in length.

STORAGE EQUIPMENT

COAL INTENDED to be stored is conveyed to the top of the storage building and in traveling the runway shown in Fig. 2, it may be tripped into any one of the

FIG. 2. CONVEYOR RUNWAY AT TOP OF STORAGE HOUSE

13 storage hoppers. Each hopper is constructed of 3/8-in. steel plate with an 8-in. reinforced concrete lining, and is closed at the top, making it virtually air-tight. Placed in each hopper is a thermostatic device, which,

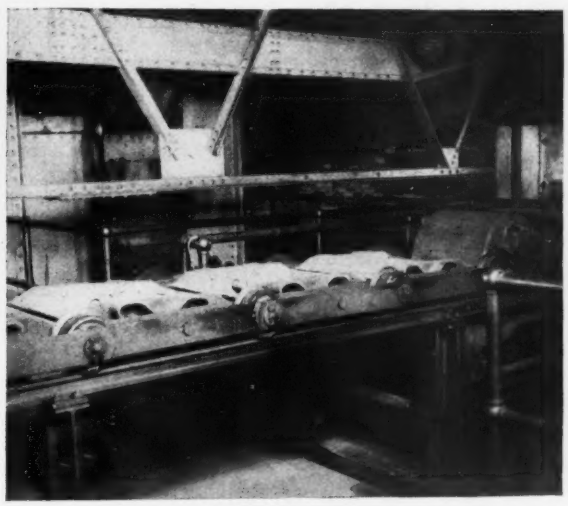


FIG. 3. STORAGE CONVEYOR TRIPPING INTO BOILER HOUSE CONVEYOR

in the event of a dangerous rise in the temperature, will ring a bell on the engine room switchboard.

For the purpose of extinguishing a fire in a storage hopper, a 1½-in. steam line runs in from 2 opposite sides at the bottom of the hopper and each branch connects to a 1-in. manifold which is placed inside of a

horizontal concrete beam. Each manifold contains 5 ½-in. nozzles through which steam at 25 lb. pressure is discharged into the hopper to smother combustion.

To carry coal from the storage hoppers to the boiler room hoppers, it is dropped upon the lower run of the storage conveyor and, after traveling down under the crusher and through the uptake, it starts back toward the storage hoppers, but almost immediately is tripped at the crossover with the boiler-house conveyor, as shown in Fig. 3. After rising over the ash tank, as shown in the view, the boiler-house conveyor runs through the enclosure of the upper boiler house bunkers. The conveyor apparatus is accessible through sliding doors on the enclosure.

Each of the 5 320-hp. Sederholm boilers and a separate superheater is served by 2 steel hoppers, one being placed above the other, as shown in Fig. 4. Coal from the conveyor is tripped into the upper or receiving hopper having a capacity of 70 tons, and then drops through a hydraulically operated gate into the lower or weighing hopper which holds 20 tons. Scale beams for each weighing hopper are located along the wall of the gallery and are shown to the left of the view in Fig. 4. Through specially designed coal gates and double spouts, the coal is discharged from the lower hopper to the stokers.

Lighted lamps designate the locations of push buttons which are conveniently spaced along the entire coal handling system. In emergency, pushing one button will serve to throw out the circuit breaker of the line to the motors and stop the entire system.

In case both conveyors are out of service, coal may be delivered to the boiler room bunkers by means of industrial cars which are filled from auxiliary doors in the bottoms of the storage hoppers. These cars are then raised to the gallery shown in Fig. 4, and dumped through side doors into the lower hoppers.

Three methods are available for handling the ashes. Under the usual operating conditions, they are carried by a steam ejector system through an 8-in. line to a 40-ton storage tank which is located directly over the driveway. In an emergency, they may be delivered to the tank by the boiler house coal conveyor or by the industrial cars.

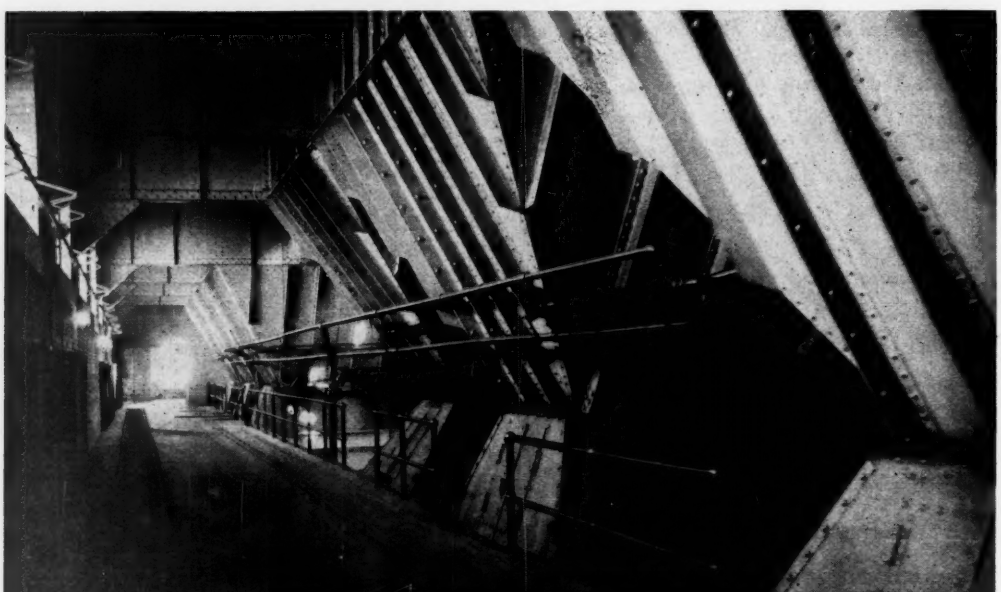


FIG. 4. BOILER HOUSE GALLERY AND HOPPERS

Maintenance Cost of Chain Grate Stokers

TO many, the cost of maintaining stokers has been largely guess work; recognizing this the Illinois Stoker Co. has kept a detailed record of costs, of maintaining four 10-ft. by 10-ft. chain grate stokers and the furnaces in actual service under boilers for 6 yr. The accompanying table is a summary of the results obtained which upon analysis shows that the cost of maintaining the stokers is less than one-fifth the maintenance cost of the furnaces:

COST OF STOKER AND FURNACE REPAIRS FOR 6 YR.

	Cost of Repairs For Stoker Parts and Iron Parts of Arch and Feed Gate	For Tile and Fireclay	Total
1910	$ 60.00	.....	$ 60.00
1911	14.00	$ 142.25	156.25
1912	61.12	823.17	884.29
1913	40.50	67.50	101.00
1914	3.00	217.00	220.00
1915	33.25	190.25	223.50
1916	189.01	894.70	1,083.71
	$400.88	$2,334.87	$2,735.75
Total per stoker per year	$ 16.70	$ 97.29	$ 114.99

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Generator Control--II

METHODS AND APPARATUS EMPLOYED IN THE AUTOMATIC REGULATION OF VOLTAGE

ADVANTAGES due to the use of automatic voltage regulators with alternating and direct-current generators and balancer sets on 3-wire direct-current systems may be enumerated as follows: Use of more economical lamps; fewer lamp renewals; conservation of energy; reduction in loss of energy due to lowering of voltage; and reduction in station operating force.

There are two general methods of automatic voltage regulation. In the first, as used in the Thury regulator, the field resistance is automatically adjusted by motors or solenoids controlled by a relay; in the second method, which is that employed in the Tirrill regulator, a resistance is alternately cut into and out of the generator field circuit. This is practically the only method employed in this country.

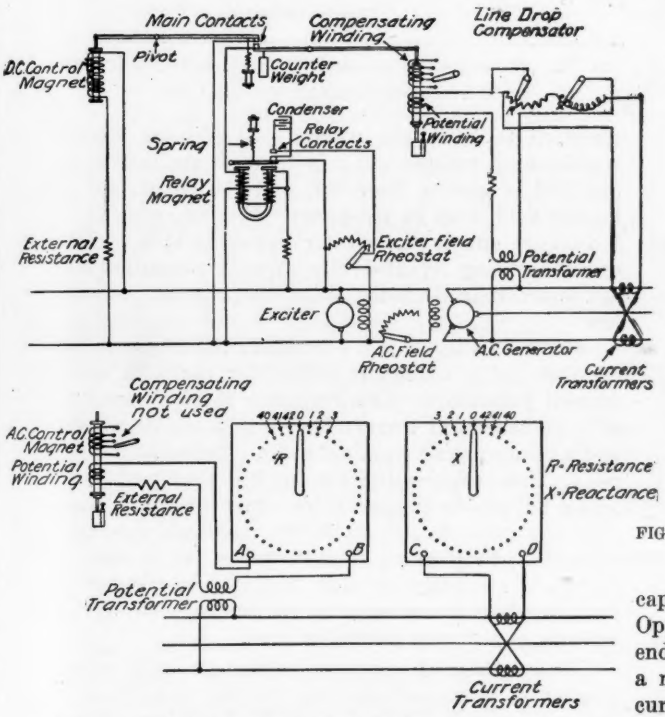


FIG. 7. ELEMENTARY CONNECTIONS, TIRRILL VOLTAGE REGULATOR USED IN CONNECTION WITH 3-PHASE GENERATOR

FIG. 8. METHOD OF CONNECTING LINE DROP COMPENSATOR

Referring to the diagram of connections of a typical regulator installation used in conjunction with a 3-phase alternating-current generator, Fig. 7, we find that the essential parts of the regulator are a direct-current control magnet, an alternating-current control magnet and a relay. The former, which has a fixed stopped core in the bottom and a movable core in the top, is connected directly across the exciter bus bars; the movable core is attached to a pivoted lever having a flexible contact

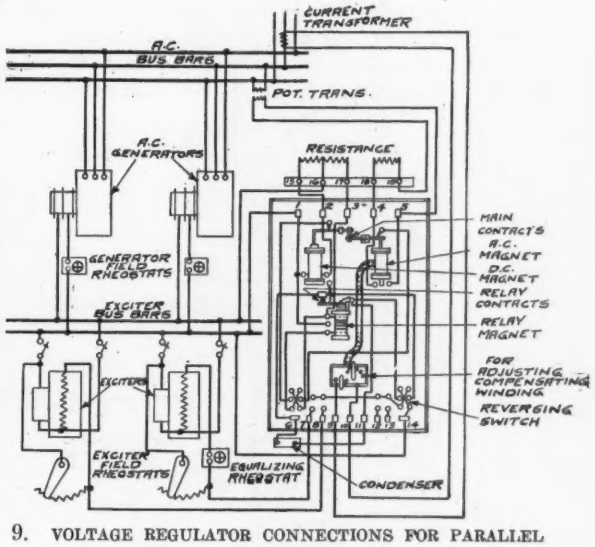


FIG. 9. VOLTAGE REGULATOR CONNECTIONS FOR PARALLEL OPERATED GENERATORS AND EXCITERS

capable of being pulled downward by helical springs. Opposite this is a second pivoted lever having at one end a contact and counterweight and at the other end a movable core under the influence of an alternating-current control coil, consisting of a potential winding connected to the main generator bus bars through a potential transformer, and an adjustable compensating winding connected through a current transformer to the main lighting feeder.

The U-shaped relay magnet is provided with a differential winding, both sections of which, like the direct-current control magnet, are connected across the exciter bus; one of these sections is connected direct while the other is connected through the main contacts. The armature used with this relay forms a means of short-circuiting the exciter field rheostat through contacts

provided for the purpose; condensers connected across these contacts prevent destructive arcing.

Where the system fed has a variable power factor such as exists on long transmission lines supplying current for a diversity of purposes, better results are obtained by eliminating the compensating winding and employing a line drop compensator. This consists of an adjustable resistance and reactance connected as shown in Fig. 8.

When, due to excessive load or otherwise, the main bus voltage is below normal, the weight of the core of the alternating control magnet overcomes that of the counterweight and closes the main contacts, causing the relay magnet to act upon its armature and close the relay contacts. This short-circuits the exciter field rheostat, raising the exciter voltage and in turn the generator voltage. As soon as the exciter voltage is increased, the direct-current control magnet exerts a greater pull upon its core, which, being attached to the pivoted lever, raises the upper main contact; and with the bus voltage below normal, the lower contact follows. As the bus voltage, however, approaches its normal value, the main contacts are opened, the relay magnet is caused to draw down its armature, the relay contacts are opened and the exciter resistance is again cut into circuit. Due to the sensitiveness of the magnets, this operation is continued at a high rate of vibration and, as a result, a pulsating exciter voltage of required value is maintained.

Figures 9 and 10 are diagrams of connections of a voltage regulator used in connection with parallel operated generators and exciters, and of a regulator employed with one or more generators using one exciter, respectively.

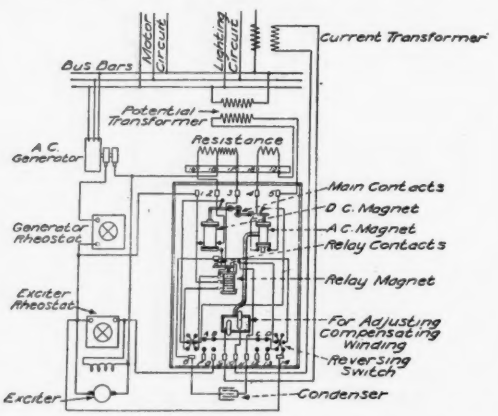


FIG. 10. VOLTAGE REGULATOR CONNECTIONS FOR ONE OR MORE GENERATORS AND ONE EXCITER

REGULATION WITH CONSTANT EXCITER VOLTAGE

STATION AUXILIARY light and power equipment is frequently dependent upon some source of direct current and as frequently the exciters are the only direct-current generators in the plant, the Tirrill regulator as ordinarily applied cannot be employed without variation of the exciter bus voltage. For such installations, the following scheme has been devised and developed by the General Electric Co.

A booster is inserted, as shown in Fig. 11, between the bus and the fields of the alternating-current generators. The field of this booster is separately excited by means of a small exciter which, in turn, has its fields excited from the difference in potential between a point on either a resistance connected across the exciter bus, or where a storage battery is employed, the middle tap of this battery, and a point of variable potential on a series of three resistances. These are connected across the exciter bus so that the booster may be excited with either polarity as required.

The regulator is connected across one resistance R-3 which is equal to about 4 times resistance R-1; resistance R-1 is equal to twice that of R-2. Should, therefore, resistance R-3 be short-circuited by the regulator, resistance R-1 being twice R-2, the current flows in a

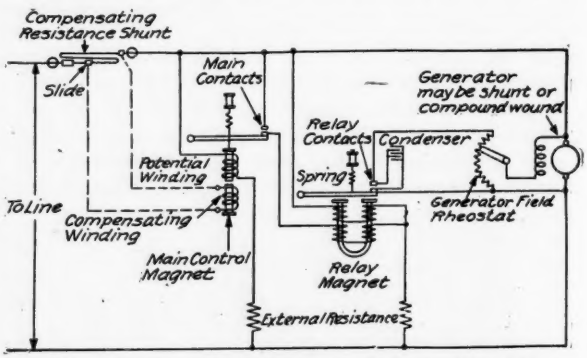


FIG. 12. ELEMENTARY DIAGRAM OF CONNECTIONS FOR TIRRILL DIRECT-CURRENT REGULATORS

direction to boost the voltage. Should the contacts remain open, resistance R-3 is inserted; the sum of R-3 and R-2 is greater than R-1, and the current in the booster field flows in the reverse direction, causing the booster to oppose the exciter voltage. This cycle of operation being repeated very rapidly, a constant voltage is maintained on the alternating-current generator bus.

Shown in Fig. 12 is a diagram of the necessary connections for a voltage regulator for use with direct-current generators. This regulator consists essentially of a main control magnet having a potential winding and a compensating winding, and a differentially wound relay. The compensating winding is generally connected to an adjustable compensating shunt placed in series with the main feeder, while the potential winding is connected directly across the feeders, as is also one section of the relay winding; the other section of the relay winding is connected to the bus bars through the contacts of the main control magnet.

With a drop of generator voltage the main control magnet is weakened and due to the tension of the spring above, the pivoted lever is drawn upward and the main contacts closed. The lower section of the relay magnet is thus energized, neutralizing the action of the upper section, and due to the action of the relay spring the relay armature is lifted, the contacts closed and the generator field rheostat short-circuited. This, of course, causes a rise of voltage which, acting upon the windings of the main control magnet, draws its core downward, the main contacts apart and opens the circuit of the lower section of the relay magnet winding; the relay contacts now open, the generator field rheostat is again

cut into circuit, and as a consequence the voltage drops. The cycle is then repeated, and due to the high rate of vibration maintained, the terminal voltage of the machine may be kept at any desired value depending upon the adjustment employed.

As in the case of the alternating-current regulator, a condenser is connected across the relay contacts to prevent destructive arcing.

Balancer Regulators

Essentially the equipment necessary to maintain a balanced voltage on a 3-wire direct-current system employing a balancer set consists of 4 relay magnets and a main control magnet arranged and connected in the manner illustrated in Fig. 13.

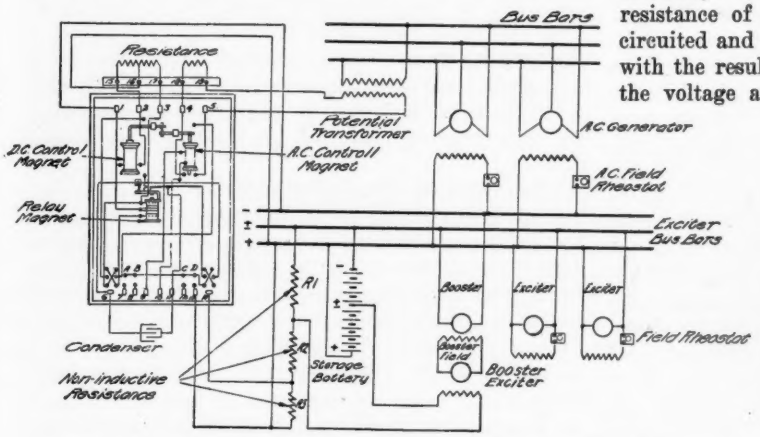


FIG. 11. REGULATOR CONNECTIONS WHERE 2 PARALLEL OPERATED EXCITERS ARE EMPLOYED IN CONNECTION WITH STORAGE BATTERY AND BOOSTER

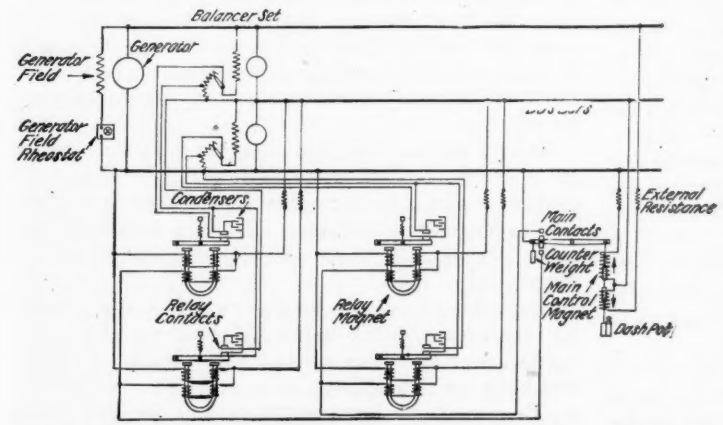


FIG. 13. REGULATOR CONNECTIONS FOR MAINTAINING BALANCED VOLTAGE ON BOTH SIDES OF 3-WIRE SYSTEM EMPLOYING BALANCER SET

Referring to the diagram, we note that the winding of the main control magnet consists of 2 sections connected in series with resistances, across the 2 outside lines and their common connection tied to the neutral. Should, therefore, the voltage across the upper lines and neutral become greater than that between the lower line and the neutral, the lower section of the main control magnet would pull downward on its core and, as a result, the upper regulator contacts will close, thus opening the contacts of the relays on the left and closing those of the relays to the right. This inserts all resistance in the field of the lower balancer and short-circuits that in the field of the upper balancer, causing the former to act as a motor and the latter as a generator to raise the voltage across the lower bus bars until it reaches and exceeds that across the upper bus bars. The upper section of the main control magnet winding will now exert the greater pull, and as its plunger is drawn upward, the lower main contacts are closed and the contacts of the relays at the left opened and those of the relays at the right closed. We now find that the resistance of the field of the lower machine is short-circuited and that of the upper machine cut into circuit with the result that, due to the action explained above, the voltage across the upper bus bars will be raised.

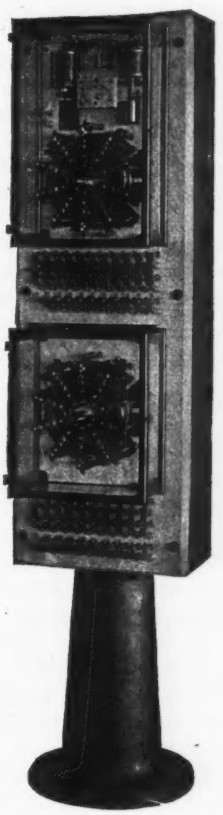


FIG. 14. GENERAL ELECTRIC TIRRILL VOLTAGE REGULATOR MOUNTED ON PEDESTAL

This cycle of operation is then repeated at a high rate of vibration, thus maintaining a balanced voltage on the system.

U. S. Civil Service Commission announces an examination, April 10, for mechanical draftsman. Two vacancies at the Naval Torpedo Station, Newport, R. I., one at $4.24 and the other at $3.52 a day, and future vacancies at any navy yard or other naval establishment at salaries ranging from $3.52 to $6 a day, will be filled from this examination. Applicants must have reached their twenty-first birthday. Apply for Form 1312.

Why He is a Great Engineer

By N. G. Near

WHY is a "great engineer" a great engineer? Is he exceptionally brilliant all the time? Does he spend every minute of his life in doing great things?

No. All great men seem to be exceedingly common. It is a usual thing to hear people remark after talking with a celebrity: "I don't see anything very wonderful about him. He is just like any other man."

When we talk to or work with a very prominent engineer, therefore, we shouldn't be surprised to find that he talks much as we do, thinks in the same way, acts about the same, eats in exactly the same way, likes potatoes, soup, beek steak and dessert, and is NEVER really brilliant. Become well acquainted with the man and he may even become a bore, although you will still admit that he is a "good engineer."

Take, for example, a certain chief engineer who is acknowledged by all acquaintances to be a "dull" fellow on the surface, yet can get more work out of a pound of coal than could any of the chiefs who preceded him.

When this chief started his career as a fireman, he was scrutinized dubiously because of his small stature. But he had been recommended as a "hard worker" and so was given a trial.

He made good as a fireman. He was not exceptionally strong, but he was active in body and mind. It was seldom that he said anything, for he was a poor conversationalist. He watched the other firemen, did as they did, obeyed instructions without a murmur, asked a question now and then, blinked his eyes, worked on and on and was soon an A No. 1 fireman. In fact, he was soon firing in a better way than the other men, but he was the only one who knew it. He was not boastful. To the other firemen he was just an "ordinary" fireman, whereas, in fact, he was en route to greatness.

Of course, he could not be held down, for he was not yet in his natural place. He quietly advertised for a place as assistant to an engineer where advancement was possible where merit deserved, and when he "landed" the job he sought, his former associates were already saying, "He's got his nerve. I have forgotten more about firing than he ever knew, and now he's starting as an engineer already."

His chief, though, had recognized his ability as a fireman by this time, and gladly wrote a recommendation for him as a "good" fireman. He regretted the loss of the man, but was at the same time glad to see him get on in the world.

In his position as assistant to the engineer events occurred in the same order as when he was fireman. His mind and body were always active. He didn't waste time with useless talking.

When his chief left he was put in charge, being the only assistant, and he himself was given an assistant, chosen by the chief before his promotion.

He handled the position in "good shape" as the owners expressed it, but away down in his own heart he was dissatisfied, for he knew he could handle it in "better shape" if he could get the materials with which to do it. By talking to the owners he could not make the desired impression, for he didn't talk, act or look like a "great" engineer. In the eyes of the owners he was just an ordinary engineer and they thought they knew just as much about machinery as he did.

But not so. This man was not born to be downed. He realized that the owners must be approached in a different way and that he must "show" them that he knew what was needed, and this is the way he did it:

He wrote a sort of "analysis" of the plant, especially of the part of the plant where additional equipment was needed. He quoted excerpts from articles he had read in technical journals to prove that greater economy was possible. He pasted clippings from catalogs of manufacturers in the analysis to clinch his arguments and actually "show" by means of illustrations that he knew the very machine that was needed. He computed the savings and profits. Here and there he pasted an advertisement clipped from one of the latest journals in which it was told just what the machine was doing for others.

All of this was done when he had nothing else to do—principally at night. The analysis was no small task, but before he submitted it he made sure that it was well done. He did not go to the extremes that would have endangered his report, for he knew that the owners did not have the money to spend on extremes. His request for new machinery was therefore made well within reason. He hit the "highest spots"—the biggest leaks—first.

The handing in of this carefully worked-out analysis, which represented many nights of labor, looked like a decidedly "brilliant" act to the owners. They had not thought that this "ordinary" engineer was capable of such complete understanding of a power plant, and from that time forward they respected his word.

He got exactly what he wanted. After installation of the machinery the plant behaved just as he had predicted. His salary was raised and so was the salary of his assistant.

Before he left that plant, leaving it in the hands of his assistant, he had made it almost first class. The owners by that time were virtually giving him anything and everything he wanted. He used excellent judgment, though, in refraining from asking for the impossible.

So, today, I call this man a truly "great engineer." He is a plodder. He knows his power plant from the coal yard to the chimney and wire outlets. His mind and body are still active.

He doesn't do brilliant "stunts." He still prefers to say little. The single, simple little word "do" seems to be his life's slogan. He appreciates a good joke, snores when he sleeps, and likes corned beef, cabbage, mashed potatoes, and rhubarb pie just like the rest of us. In fact, the people who do not know what it means to be a chief engineer, and who know this chief only casually, say that he is a "dull" person.

U. S. Civil Service Commission announces an examination for skilled laborer, qualified as elevator machinist, on April 18. A vacancy in the Department of Agriculture, Washington, D. C., at $900, and future vacancies requiring similar qualifications, at salaries of $900 to $1000. Apply for Form 304.

Points on Raw Water Can Ice

FOR SUCCESS, USE SUITABLE WATER, AND AGITATE CONTINUOUSLY UNTIL BLOCK IS SOLID. BY V. R. H. GREENE

IN THE early efforts to freeze clear ice from raw water, air was forced down a tube suspended vertically in the can. This blowing at low pressure washed the air bubbles from the forming ice and gave clear ice up to the point where the ice blocked the outflow of air from the tube, when a white core was formed. To overcome this, the tube was removed just before the ice reached it, the core water drawn out and distilled water put in, which froze clear, giving a transparent block.

As the odor and taste of distilled water ice were thus left in the core, a core of fresh raw water was tried, which gave better results than freezing in the original core, and the next step was to find some means of blowing air through this core until it was completely frozen.

By experimenting, Mr. Beals of Detroit determined that using 2 lb. pressure would keep air blowing through the water even after the ice had formed around the tube outlets; and drying the air would avoid closing the outlets from within by moisture condensed and frozen inside the tube. But to avoid reducing the temperature of the air below 36 deg. F. in the drying process, yet maintain a dryness which would not give condensation of moisture when the temperature falls to 14 deg. in the blowing tube, it was found necessary to subject the air to 45 lb. pressure and allow it to expand in the tube down to about 2 lb. This requires some care on the part of the operating engineer to avoid cooling the air below 32 deg. F., which might freeze up the apparatus, and to avoid letting the temperature rise above 40 deg. F., which would raise the dew point in the drop tube above the temperature of the brine and result in freezing up the tube.

Also the high-pressure blowing requires more power than does the low-pressure, the excess being uncertain, but probably twice as much.

With the design used by the Independent Ice Co. of Baltimore, Md., the tube is suspended from the sides of the can into the water, and by compressing to 25 lb., cooling to 36 deg. F. to dry out moisture, and then expanding to 2 lb., it is possible to keep above the dew point at the temperature of the ice, some 20 deg., and get the same results as with the higher pressure in the Beal system. The tube is frozen into the ice, but is removed when the can is lowered into the thawing tank by sending a steam jet into the ice block. For an electrically driven plant, it would be necessary to wind the tube with a high resistance wire through which current could be sent to thaw the tube loose. But this leaves a hole in the block somewhat over 0.5 in. diameter which might be objectionable for some classes of trade.

Use of grids to remove discoloration in the top of the block has, in the writer's opinion, been found unsatisfactory, as the color will extend into the fishtail in the top of the block below the grid. If the water is unsuitable for ice, it should be treated chemically and filtered; then the air agitation will produce clear, perfect blocks. Most waters will, however, give clear raw water ice without chemical treatment.—Refrigerating World.

Economical Lubrication in Ammonia Compressors*

BY J. W. FROMEYER

ICE is manufactured under 2 systems. One is called compression, the other absorption. In the former more power is required to drive the compressor, to which the Corliss engine coupled to it must be of larger dimensions and greater power than the one needed in absorption. Hence the lubrication of the compression type requires a more substantial bodied oil, while in the smaller engine, in absorption systems having less stresses, a lighter bodied oil suffices. It should otherwise be of similar character for compression type engines, namely, having the ability to separate freely from hot water without discoloration and contamination in what is here termed "water end," and here is the seat of most oil troubles.

The other "oil troubles" come from quality and blend of cylinder oil used in what is here termed "steam end."

QUALITIES OF CYLINDER OIL

STEAM CYLINDERS of Corliss engine valve faces and seats, packing rings, and exhaust valves, should be lubricated in a satisfactory manner, but the demand on it for steam end conflicts with the quality needed for water end. In the former a slightly compounded oil will cause engines to run more smoothly, but the same oil in the water end will adhere in spots to internal piping, reboilers, oil traps, skimmers, fore coolers, charcoal filters, and possibly finished ice. This condition causes complaints from customers, hence it is highly important to improve the finished product.

Having specialized for several years in ice plants, tested all kinds of dark oils, light, medium, heavy and abnormally heavy, also semi-filtered, and highly filtered, some with 5 per cent, others 10 per cent, tarry residues, my conclusions are that a clean, dark, pure mineral cylinder stock of 24½ to 26 gravity, 180 to 200 viscosity, sweet in odor, will do the best work. Subsequent tests and investigations confirm such belief.

Pure mineral is preferred, provided exhaust valves do not groan. If they do, a slight blend is necessary, from 2 to 3 per cent of pure acidless tallow oil, so as to cause slight emulsifications, thus increasing the affinity between moisture or condensed steam and oil.

The cause for exhaust valves groaning is due to low temperature of exhaust steam at atmospheric pressure of, say, 212 deg. F., as against that for 100 lb. steam pressure initial on steam valves.

After steam expands the moisture washes off the oil, leaving valves dry, causing groans.

Greater affinity exists at higher pressure, because the vibrations of heat in steam atomize the oil more freely, hence the saturation point permits better lubrication of cutoff valves.

If the slightly blended oil does not prevent groaning, the following is recommended: Attach a force feed mechanical lubricator, and feed a mixture of pure mineral cylinder oil and special prepared graphite, in proportion of one tablespoonful to one quart of oil. I found this to hold down the heaviest valve gear; beside

*From an address before the Oil Men's Association.

it will not injure the water end nor ice. I tested this during one whole season satisfactorily.

Imperfect Lubrication

By this we mean groaning of cutoff and exhaust valves, tremoring of eccentric rods, excessive wear on lubricated surfaces, such as valve faces and seats, on both cutoff and exhaust. Also an imperceptible wear of displacement surfaces in cylinders by the sweep of piston and expansion packing rings. Excessive wear of catch blocks, interfering with uniform tripping of dashpots. Wearing of eccentric straps, needing rebabbiting. Wearing of valve gear bearings. All these features can be identified by resulting noises audible to the ear, as well as heating of eccentric straps so familiar to engineers.

Groaning of valves is mainly due to faulty or imperfect lubrication, already explained. When steam valves wear they leak steam and eat up the coal pile. This lowers initial pressure at opening, reducing the expansion power of steam, besides such leaky steam raises the pressure when the exhaust valves open, and if not released in time creates back pressure, with too great compression, which causes the engine to knock, and exasperate the engineer.

All of these imperfections are largely attributable to poor lubrication, adding their sum total of cost of unnecessary friction, as indicated by lost power. This lost power measured in dollars and cents far outweighs first oil cost.

Take a concrete case, a 100-ton ice plant. This requires a 400-hp. Corliss engine. Engine builders rate it as creating a friction of 12½ per cent, or 50 hp. with average oils.

We now propose to lubricate with good oil which has the surplus power and ability to preserve a solid film, though in atomized form, better than the oil used originally.

We now test actual friction produced by means of a steam engine indicator, attached with one 3-way cock, to make it flexible for testing distribution of steam from head and crank end separately.

Taking friction cards from each end of the cylinder and figuring the i.hp., a really good oil, as described, will show 40 hp. instead of 50 hp. previously shown, hence 10 hp. is saved.

Now, let us see what this costs in coal. The engine consumes 3.8 lb. coal per horsepower per hour, so we multiply this by 10, equals 38 lb. coal saved each hour. For one day, 24 times 38 gives 912 lb. of coal.

Next multiply this by number of days a barrel of oil lasted, or 50 days, and we have 46,600 lb., which equals 23.3 tons; and at $2.50 a ton, we have $58.25; this represents the cost for 10 hp.

This is not all. Now add $15 paid out for 50 gal. of oil at 30 cents per gal., and we have $73.25. Divide this by 50 gal. and the ultimate cost of this oil is $1.46 per gallon, compared to invoice cost of 30 cents per gallon for the poor oil. Compare with price, 60 cents per gallon, and it shows why the better oil is cheap at that price.

Fortunately, this plant is using a modern force feed lubricator that breaks up a large drop of ¼ in. down to 16 small drops of 1/64 in., same volume as ¼ in., and instead of feeding 6 drops, with a hydrostatic lubricator feeding oil through water, we can now use 16 times 6, or 96 drops; but instead we use 48 small drops, one to each revolution, and thus save 50 per cent cylinder oil. Therefore we use 25 gal., which at 60 cents is $15, the same cost as for the cheaper oil.

Now refer back to former case, and we find an actual saving of $58.25 was made by buying good oil.

Backed with years of experience, I am conservative in saying that more money is actually lost in 60 per cent of the steam plants in this country by unnecessary friction than the total cost paid for oil.

Common Salt for Preserving Wood

By Mark Meredith

MANY methods are in use for preserving wood and preventing it from rotting. Most of these, such as chloride of zinc and the sulphate of copper treatment, are comparatively expensive, and are applicable, therefore, only to the better classes of wood; moreover, they can only be used by the large industrial works, and are not suitable for private use. It has now been discovered that ordinary common salt is an excellent substance for impregnating wood and for preserving it against decay. The effects of the action of common salt on wood were first noticed at the Great Salt Lake in Utah. It was observed that the sleepers of a railway line which was continuously washed by the very salt waters of the lake needed no renewal, and after 43 yr. were in a far better state of preservation than oak sleepers impregnated with expensive chloride of zinc after 14 yr., when the latter required renewal. In consequence of this discovery, numerous and comprehensive experiments have been made to ascertain the effect of salt impregnation of wood, and it is reported to have been entirely satisfactory. It has been determined that a solution of common salt kills all the bacteria of decomposition and prolongs the life of the wood for practically an unlimited period. The discovery should have a tremendous effect on the wood industry, especially in connection with ships, railways, house-building, etc.—Machinery.

In connection with the necessary preparation for what may come in the near future, Secretary Baker recently requested the National Chamber of Commerce to appoint local committees to co-operate with the Government in arrangements for purchasing supplies now authorized by law for the army. The work of organizing these committees was placed in the hands of Bascom Little, formerly president of the Cleveland Chamber of Commerce, and chairman of the committee of the National Chamber of Commerce on National Defense, and the work has been so promptly done that the committees are now practically complete. Their personnel is announced in the March issue of The Nation's Business, the official magazine of the National Chamber.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Sparking Collector Ring

IN THE editorial columns of the Dec. 1 issue was an interesting article headed, "Opportunities for Young Engineers in Hydro-Electric Plants." I quite agree with the editor in that such "professional exile" offers great opportunities, the greatest, perhaps, being that for study. But after reading Practical Engineer for several months and seeing our "brothers in steam" argue various topics (relative to steam plant operation) my curiosity has naturally been aroused as to why we can't have a few articles from the many hydro-electric plants throughout the country.

It's true that operating conditions may not be as uniform in the various localities as they are in steam practice, but surely we have something in common to discuss. I hardly think operating conditions have reached that degree of perfection whereby trouble ceases to exist; at least, such has not been my experience.

I am writing this from a station that reckons its kv.a. capacity in hundreds instead of thousands, so troubles are few. Nevertheless, I have them. For instance, a while ago I noticed a sort of pitting on the positive collector ring of the 3-phase umbrella type generator. It appeared in one spot about 4 in. in length, slightly wider than the brushes, and felt like a piece of fine sandpaper. You may imagine the display of fireworks when this passed under the brushes. Since no remedy short of a new ring seemed apparent, it was allowed to run "sparking" for some time.

Shortly after, a discoloration was noticeable on the negative ring. This time the ring appeared oily, hence a clue.

The rotor and direct connected turbine being suspended from a thrust bearing at the top of the generator, and immediately above the collector rings, the source of the oil was readily located.

I learned later that one lead gasket had been left out of this bearing; in fact, it was crowded out by a slight excess in foundation height.

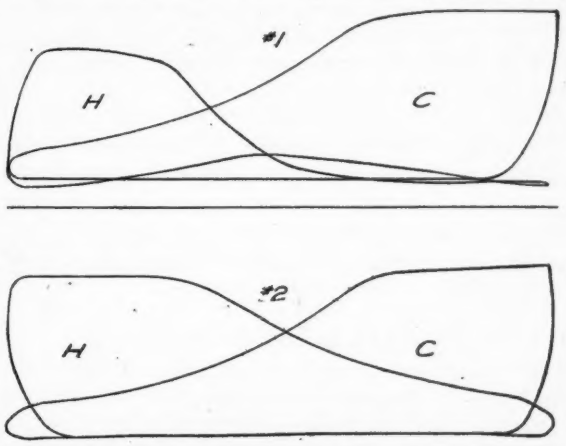
While new, the bearing gave no trouble; but after about 3 yr., oil began to come down the shaft. As this machine was running practically all the time and could not be spared from service long enough to correct the fault, something else had to be done. By wrapping several layers of cloth around the shaft immediately above the rings, I managed to collect the oil as it came down. Then, by changing cloths about once a week, no more trouble was experienced. Whether or not the oil caused the pitting and discoloration, I cannot say; but since keeping the oil from the rings has eliminated the sparking, and sparking served to augment the pitting, I'm inclined to believe the oil was the cause. Any remarks to the contrary?

I could enumerate other "joys" of the "exile," such as cutting ice away from the dam with the temperature 20 deg. below zero and a 50-mile wind blowing; but that comes under the heading, "Grief," so will not include it in this letter. Now, fellows, "jar loose," and tell us what you're doing. I'll guarantee the "wheels" will keep going for the few minutes it will take to tell us some of your troubles. K. D. FENDERSON.

Using the Indicator After Accident

THE VALUE of the steam engine indicator in showing what transpires within the cylinder and in locating trouble is well proven by the following instance.

The high pressure cylinder of a 26 by 56 by 72-in. cross compound Corliss engine operating a textile mill at 1400 hp. load suddenly developed a groan and choking sound as when a dose of water comes along. The receiver pressure immediately jumped from 6 to 13 lb. and continued there. The engineer in charge hastened



CARDS TAKEN IMMEDIATELY AFTER ACCIDENT AND AFTER VALVE WAS REPAIRED

to open all drips and traps, but found no signs of water. The cutoff on the low-pressure cylinder was lengthened to reduce the receiver pressure. During the period of admission on the head end of the high-pressure cylinder, a pronounced roar would be heard in the exhaust pipe, indicating the pressure of live steam. Indicators were at once put on and the resulting cards are shown above. At shutting down time at night, the cylinder head and valve bonnets were removed and the head and exhaust valve taken out. The sequence of events as shown by the inspection of cylinder and valves must have been as follows:

A follower bolt had come out, dropped through the exhaust port and was momentarily caught between the

working edge of the exhaust valve and the edge of the port in the exhaust passage. Instead of this breaking the valve arm or wristplate as often happens, it twisted the valve stem, which in the Corliss engine is separate from the valve, through an angle of about 30 deg. The bolt was freed, passed down into the exhaust pipe, and the valve continued to operate, but, due to the twist in the stem of the exhaust port, was open about 5/8 in. at the point of admission, and all other events were proportionately out of place as shown by the card.

A new stem was fitted, the valve properly set, and the resulting cards the next morning are shown as No. 2. Extremely fortunate were the owners of this engine because of the possibility of any of 3 things happening under similar circumstances with consequent damage to the engine and loss of production. First, as the follower bolt backed out it could have struck the cylinder head, which would undoubtedly have broken the piston; second, as the bolt dropped down it might have been caught between the piston head and cylinder head, breaking either or both, and wrenching connecting rods, crankpins, etc.; third, instead of the valve stem yielding to the twisting strain, the valve arm or wristpin might have broken, and in any of these instances serious damage and loss of production would have ensued.

C. A. J.

Recharging Dry Cells

PERHAPS the readers of Practical Engineer would be interested to know of a simple method I have successfully employed to recharge flash-light and other ordinary dry cells which, as a rule, are discarded after once exhausted.

Of course, direct current only may be used. With 2 20-w. lamps connected in series I attach the negative side of a 250-v. line to the zinc casing of the shell and the positive line to the carbon terminal and after a charge of from 2 to 3 hr. I have revived a dead cell to its former capacity. This process may be repeated as long as the chemical contents of the cell remain moist. I have frequently recharged flash-light batteries as many as 20 times, thus reducing their ultimate cost to a minimum.

In order to distinguish the polarity of the leads of a direct-current circuit, dip them in a brine solution; the negative lead may readily be recognized by the formation of the bubbles around it.

L. A. FITZ GERALD.

Improving the Diagram

THE FOLLOWING example should prove of value to some of our readers. Figure 1 shows a steam line leading from a battery of boilers to a Corliss engine. The engine was a new installation and the size as shown by the cut. These boilers had a cross steam header, as shown, and this header being 8 in. in diameter, was reduced down just as shown at E; this 5-in. line was a part of an old installation, which had been in place in a former engine that had run the present plant, but the 8-in. header was new. The 5-in. bend was new, which led to the Corliss engine, 18 by 36-in., running 100 r.p.m., this giving us 600 ft. piston speed, and our steam pressure being only 80 lb.

We got a wire drawn line, as shown on the indicator card No. 1; however, with this condition our engine would not carry the load. The engine being a single eccentric type and the exhaust valves closing quite early gave us a late release, as shown at B, and with this extra compression and slow release, the engine would hook up and would not carry the load at times, so the exhaust valves were set so as to open quicker, and consequently close later, leaving less compression. The engine would carry the load under the new setting but, of course, we had to remove some of the play that was left in the crank bearing, by cutting off the compression. The play on the crankpin was more perceptible, and the engine became very noisy until the play was removed. Card No. 2 shows the engine working on the same load after the exhaust valves were made to open quicker.

Many engineers claim that high compression does not reduce the horsepower of an engine, but this was a fair example along this line.

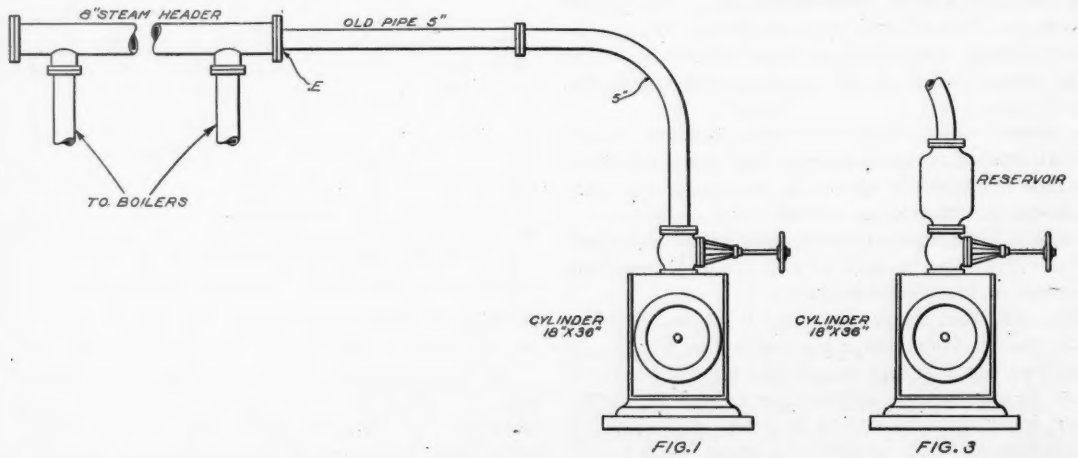


FIG. 1. THE PIPING TO THE ENGINE
FIG. 3. RESERVOIR TO HOLD PRESSURE STEADY

Card No. 3 was one of the latter; while this is not presented as a show card, it is not a bad card from a single eccentric engine. If this engine had a proper steam line, the card could be developed into a fine one. It is a good card for such low steam pressure when compared with the piston speed of the engine. Under this setting, however, the engine is carrying its load fine without hooking up. This engine would do better by removing the piece of pipe running from the main header over to the 5-in. bench, while the engine only has an opening large enough for a 5-in. pipe. The length of the bend plus about 12 ft. of this small pipe runs up the friction loss on this low steam pressure under the high piston speed of the engine.

I have corrected this kind of steam flow troubles in mains where the boilers were located a great distance from the engine by putting in a reservoir drum as shown in Fig. 2. This reservoir helps to maintain the pressure at the throttle by supplying the quick demand for steam which is made by the large cylinder which is calling on the small steam pipe for more steam than it can furnish. Not only do these conditions require more fuel to operate, but they actually hamper the power of the plant. In this particular case they needed all the power that could be had. C. R. McGahey.

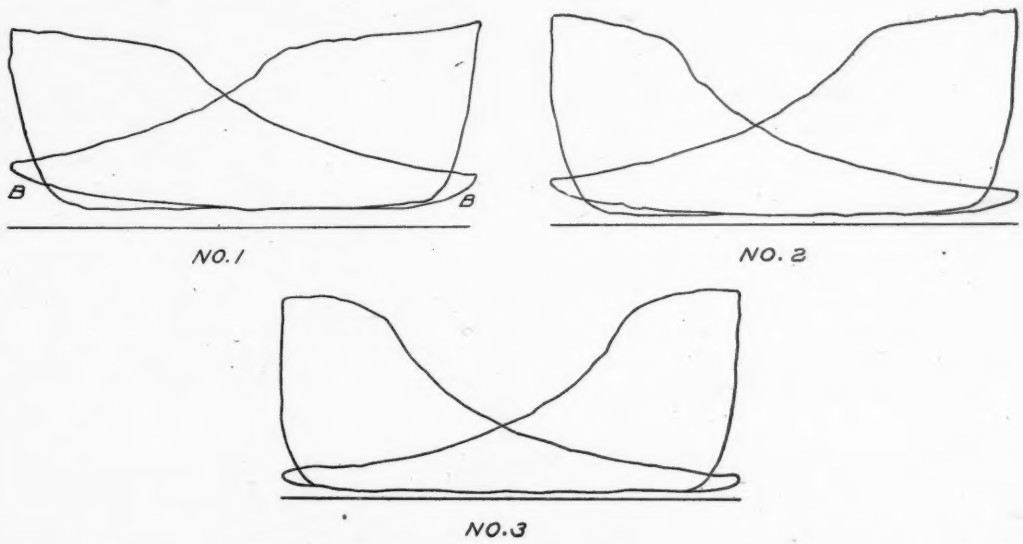


FIG. 2. INDICATOR DIAGRAMS BEFORE AND AFTER

Pump Troubles

READING ABOUT trouble with obstructed pipes reminded me of a little difficulty with a boiler feed pump which I observed in a heating plant some time ago. The pump was an ordinary duplex, taking water from an open type heater, except during emergencies, when it would be made to lift from the well, putting the water in the boiler through a closed type heater, which was ordinarily used for other purposes. When making this change, in order to get the pump to "pick up," it was customary to close the discharge valve and exhaust the air through the vent in the top of the valve chamber.

On the occasion referred to, it became necessary to cut out the feed-water heater, and the valves were changed so as to pump from the well; but it wouldn't lift the water. After making a few strokes it stopped. When the steam was shut off it backed up to the ends, showing plainly that there was a back pressure some place. Some one suggested an obstructed exhaust pipe, but a search showed the exhaust to be all right. Then it was tried again, but with the same result.

Of course, by this time the readers of Practical Engineer have been able to guess the cause of the trouble; but, unfortunately, this engineer had not availed himself of the opportunity of keeping up with the "kinks," so he had to look again. When he did locate the trouble, which was more by accident than otherwise, it was just where everyone has guessed—the vent was stopped up.

J. M. Row.

Results With Oil As Fuel

I READ Mr. Montgomery's article in Dec. 15 issue, also Mr. Row's criticism, with interest. I agree with Mr. Row that an increased temperature over 135 deg. is a decided benefit in atomizing the oil. Mr. Montgomery does not state whether his burners are "back shot" or spray the oil directly under tubes at the front end of the boiler. Also whether the boilers have horizontal or vertical baffles: these omissions would be of aid in discussing oil burning systems. Draft regulation is most important for good economy when using oil as fuel. The way the burner is set, i.e., distance from grates, air spacing under burner and the angle the burner is set with the grates, is another important feature; also, burners being kept clean will add materially to good economy. The evaporation obtained, 14.4 lb. water per pound of oil with boiler efficiency 72.7 per cent is very good. The oil fed to oil burners is measured by oil meter; as meters are not accurate, and as Mr. Montgomery does not say whether any allowance is made for increased temperature due to heating oil before going through meter (0.0004 difference in volume per degree

over 60 deg. F.), his oil measurements will not be accurate. Now, for the true evaporation: if boilers are blown down daily, is deduction made for water lost in this way, also water carried over in steam to engines and auxiliaries? It would be of interest to know the load factor and power factor with a fuel consumption of 0.84 gal. per kw.-hr. when making comparisons with other plants.

The writer has been able to obtain a kw.-hr. on 0.72 gal. fuel oil with load factor of 42 per cent from a 136-hp. piston valve engine and 75-kw. d.c. generator; also 0.73 gal. from a 4-valve (rotary), 120-hp. engine and 75-kw. a.c. alternator at load factor of 38 per cent, power factor 85 per cent. Both engines operating noncondensing, steam pressure 90 lb., water temperature 200 deg. F., fuel oil having a B.t.u. value of 18,500. Weight of oil 8.1 lb. per gal., temperature of oil 160 deg., pressure of oil 30 lb.

To obtain the best results from oil when used as fuel, it is necessary to have the system properly installed with boiler furnaces especially fitted for its use, oil to be of high temperature (200 deg.) when fed to burners, superheated steam to atomize oil as fed, oil tank at pump suction side to be of such form that accurate measurements can be made. The Pacific Coast, being the home of the oil burner, has adopted rod measurements for accuracy in selling, buying and using oil as fuel.

FRED G. HANEY.

Engine Questions Discussed

THE SEVENTH question of the Coast Artillery Corps Examination Questions appearing in the Mar. 1 issue (An engine that leaks at the piston rod packing pounds twice apparently at the crankpin on every complete stroke. What steps would you take to remedy this?) I believe is intended to indicate an engine in which the crosshead is a very loose fit in the guides. As a remedy, it should be centered and the crosshead shoes adjusted so as to prevent the pound at the crank centers due to the crosshead being lifted and striking the top guide, for at this point compression and admission (lead) are being assisted by the flywheel in changing the direction of motion of the piston, and if the assistance of the flywheel continues much after the center is passed, it may be sufficient to lift the crosshead (causing one thump) which will return to its normal position (causing the second thump) as soon as the pressure acting upon the piston becomes greater than the turning force of the wheel. This action is very noticeable in the case of horizontal compressors driven by means of a crank. The alternate up and down movement of the crosshead would be transmitted to the piston rod which would result in a vertical movement of the rod in its stuffing box—hence the leak at the piston rod packing mentioned. Many leaky stuffing boxes on ammonia compressors are due to this cause, although it must be admitted that with proper steam distribution, lead, etc., these conditions should not obtain in a steam engine.

In the same issue, W. P., in answering W. H. P.'s first question concerning the changes necessary when changing a 4-valve engine running noncondensing, to run condensing, neglected to mention one of the most important points, i.e., compression; for if the engine is to run at the same speed, the same compression will be necessary for satisfactory operation, and with the reduced back pressure due to running condensing, the exhaust valves will necessarily have to close earlier in order that steam enough to produce the same amount of compression as when running under a higher back pressure (noncondensing) be retained in the cylinder.

A. C. MCHUGH.

Guides on Float to Prevent Wear

THE WATER LEVEL in one of our large tanks was maintained by a float controlled water admission valve, the float being contained in a narrow float box attached to the side of the tank. Though there was 1 or 1½ in. clearance between the wall of the float tank and the float it did not seem possible to adjust the float from rubbing against the iron wall of the float box, as a result of which the float wore thin and finally leaked. When we installed a new float, we took steps to overcome this condition by attaching to each side of the float 2 small angles

FLOAT WITH ANGLE IRON PROTECTIONS

as shown in the sketch which formed protecting guides or wings and these wings saved the float from the wear of abrasion on the float tank, and we further noted that it resulted in freer and quicker action of the float, probably because there was not as much friction caused by the wings rubbing against the sidewalls as before when practically the whole side surface of the float was engaged with it.

M. A. SALLER.

Making Uptake Doors Tight

ONE OF the plants in my charge is provided with return tubular boilers 16 yr. old, operating with induced draft. The front connection or tube doors are considerably warped.

The result is that there is a loss of draft in the furnace and that the Orsat shows more oxygen than really exists in the furnace as the gas is taken from the uptakes for the Orsat.

I have tried several ways to make the doors fit closer, but the following, while not entirely all that can be asked for, is the best so far.

The doors were removed and a groove cut with a round-nosed chisel in the surface that bears on the front of the uptake. This groove was painted with shellac, and asbestos wicking calked into the groove. Heavy fingers hold the door tight when shut.

Has any reader any suggestions to offer?

RECEIVER.

First Aid Lockers

IT IS SURPRISING to note the lack of provision on the part of the power plant owners of any sort of First Aid lockers in the different sections of the plant. Perhaps it is not intention, but it seems to me that when there are no provisions made for First Aid treatment, it is the duty of the engineer in charge to interest the plant owner in the "Safety First" idea, for often it is first aid to the injured which counts most in saving life.

It was only after a serious accident in the boiler room of the plant in which I used to work that provisions were made; but it is better late than never, and they are now prepared to give First Aid.

A sheet metal locker of ample proportions, painted white with a red cross on the door, is in plain sight in a corner of the engine room, and right underneath it is a stretcher. Large bottles of clear distilled water are set in racks near the locker, and there are also a plentiful supply of bandages, disinfectants, preparations for scalds and burns, tourniquets for stopping the flow of blood, and many other First Aid supplies. Each bottle is very plainly labeled as to contents and use.

Instruction cards are posted on the inside of the locker door on the proper treatment of various accidents, especially electric shock. Copies are also posted on the bulletin boards of the different sections of the plant.

Every man in the plant has been taught the location of the First Aid locker; in fact, most of them have gone there for treatment for a small cut or burn, so that is the first thing they will think of in case of accident. The moment an accident takes place, the instructions from the chief are that if it is serious, a hurry call for a hospital ambulance, and a doctor is to be phoned immediately.

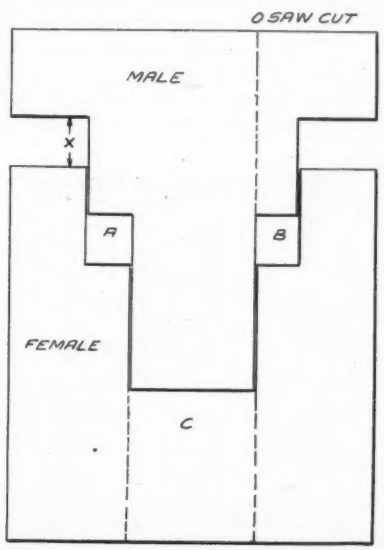
The days of applying engine oil to a scald, or any old bit of rag for a bandage, are past in our plant, and I am sure that most of us appreciate it; I know I do, and that is why I am passing on the suggestion that other plants look into the benefits to be derived from First Aid. While there is nothing new in the idea, it seems to have escaped attention in a few of the plants I have visited. In one plant I inquired if they had any provisions made for First Aid, and the chief smilingly replied: "Yes, we keep some bandages and court plaster in the drawer of the engine room desk."

C. H. W.

Metallic Packing for Pumps

IN REFERENCE to R. A. C.'s request regarding metallic packing, I have had success under very trying conditions. I have 2 air compressors which have scored rods and have packed air and steam ends with metallic packing and made them hold. The labor and expense to pack these compressors got me into the notion to use metallic packing, although I had never used it before, but I decided to make my own, and following are directions for doing it:

Take a piece of cold rolled shafting large enough to make a male and female plunger or mold, as shown by the sketch, making male plunger long enough to rise up in hole C to put in metal at X. We are now ready to form the metal. Take pig lead and melt it in a pot and add enough Magnolia or other good babbit metal to it so that when you throw a little of it out in a thin sheet on the floor you can bend it and it does not break off sharp, as pure babbit would do. You now have metal ready (do not overheat it). Now, pour through a very fine sieve, such as fly screen, placed over a can of cold water, holding ladle well above water (be careful of your eyes). You will now find your metal in flake form in different sizes. Take the small or fine size after sieving for small ring packing, and you can use larger flake for larger diameters. Dry this well and make a mixture of hot tallow or suet and flake graphite and pour over your metal flakes and mix all well. Now put this in your mold and press in a vise or press. Bump on floor and out comes your metallic packing. It is best to put a saw cut in your male plunger at O, and while in the vise take an old sharp edge saw blade and cut packing and turn plunger to opposite side and cut again. This will give a smooth edge at joints when taken out. When I first put this packing on the air compressors they leaked slightly, but I pulled up from time to time and put in another ring or two till at last



MOLD FOR MAKING METALLIC PACKING

it held for two months, when I shut down for the season. If you want to stop leaks quickly, pull up gland for a day, or till set, and put a ring of soft packing in front and it will stop leak when, after being in for a time, take out and put a metal ring in, for you can make any thickness of ring according to amount of metal put in mold.

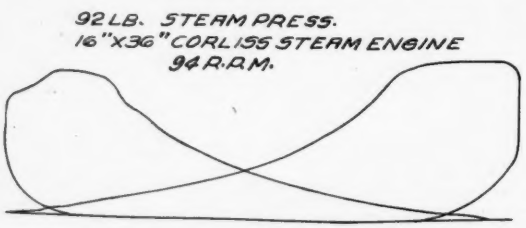
I next packed 2 Gardner boiler feed pumps which I use on a hot water forced circulation system I made to use excess hot water for bathing and domestic purposes. These pumps have run now for the last 6 mo., alternating day and night. The temperature of the water is about 140 deg., and I have not touched them since, having both steam and water ends of pumps packed with metallic packing, as described, but find you must have a certain amount of patience for a day or so till packing is set. H. L. CUNNINGHAM.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

What Is Wrong?

I WISH the readers of Practical Engineer would tell me what may be wrong with the setting of the valves of my engine as indicated by the card shown herewith. The engine from which this was taken is a simple Corliss, 16 by 36 in., running at a speed of 94 r.p.m. and working under a steam pressure of 92 lb. gage. A. L.



CARD FROM CORLISS STEAM ENGINE

Why the Corroded Fittings?

AT A IN THE accompanying illustration are shown connections by means of which trap returns and make-up were formerly fed to our receiving hot well. Our boiler pressure ranges from 80 to 85 lb. gage and the returns which are taken from the drying rooms, machines, and general heating system (this is a hat factory) are delivered to the hot well by about 40 traps of various types and makes such as the old pot or dump trap, McDaniels, Squires, J-M, and one or two others of the expansion form. With this original arrangement the traps discharged into the hot well under the water line and each time a trap dumped, considerable hammering would occur. Make-up was taken in through the trap discharge line, as may be seen, and when taking in cold water through this line, the hammering would stop. The temperature of the make-up is generally about 7 deg. C. (45 deg. F.) and that of the water in the tank is 49 deg. C. (120 deg. F.).

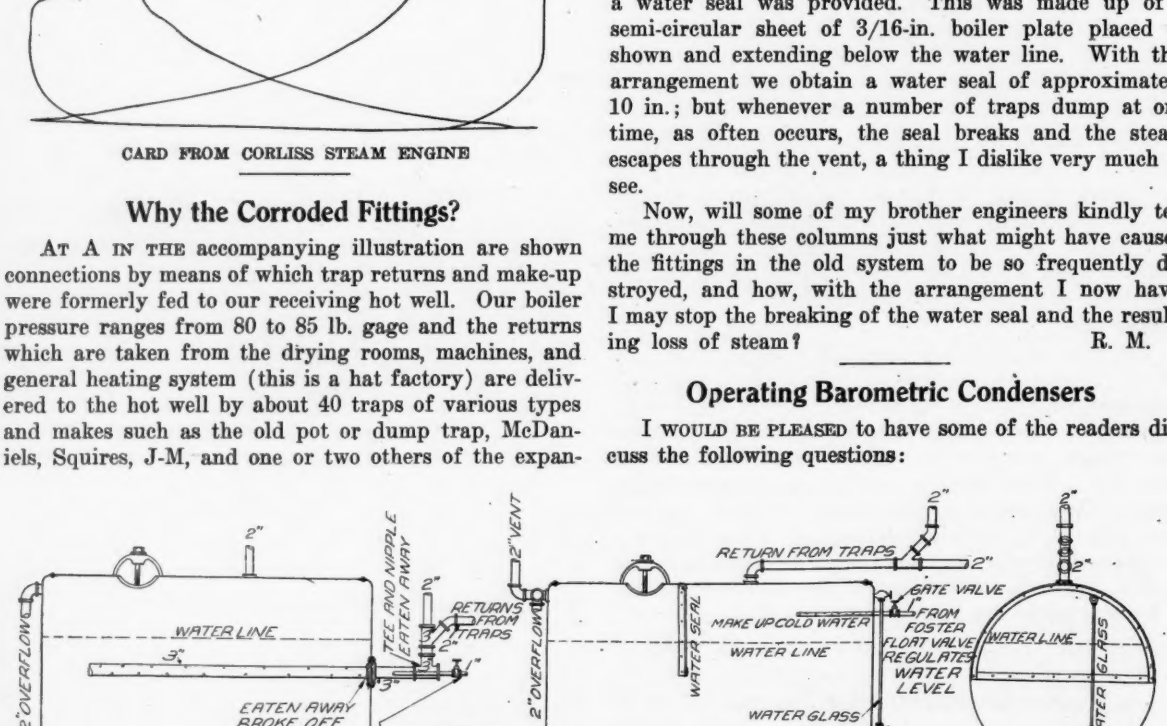
That which bothered most with this installation was the fact that the various fittings indicated were so continually eaten away and honeycombed as to require renewing them at least every 9 mo.

In our new system, shown at B, the method of introducing the trap returns was somewhat modified. The returns were brought to enter the hot well through a 2-in. connection at the top and to prevent the escape of the steam which finds its way over with the hot water, a water seal was provided. This was made up of a semi-circular sheet of 3/16-in. boiler plate placed as shown and extending below the water line. With this arrangement we obtain a water seal of approximately 10 in.; but whenever a number of traps dump at one time, as often occurs, the seal breaks and the steam escapes through the vent, a thing I dislike very much to see.

Now, will some of my brother engineers kindly tell me through these columns just what might have caused the fittings in the old system to be so frequently destroyed, and how, with the arrangement I now have, I may stop the breaking of the water seal and the resulting loss of steam? R. M.

Operating Barometric Condensers

I WOULD BE PLEASED to have some of the readers discuss the following questions:



FORMER AND PRESENT RECEIVING HOT WELL CONNECTIONS AND ARRANGEMENT OF WATER SEAL

If you were running an engine exhausting into a barometric condenser and you should lose your vacuum, how would you regain it?

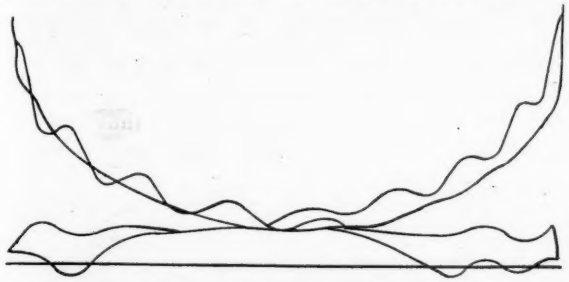
Would you keep the throttle wide open and open the forced injection valve? Would you close the throttle, then open the forced injection valve and when the vacuum started to pick up, gradually open the throttle

again? Or would you close the main injection valve, open the vacuum breaker and bring the engine to a dead stop before attempting to create a vacuum?

W. E. B.

Criticism of Diagram Desired

THE ACCOMPANYING indicator card was taken from a Fitchburg engine with a cylinder 13 by 13 in., the speed was 256 r.p.m. and the steam pressure 80 lb. A



FREAK CARD FROM FITCHBURG ENGINE

50-lb. spring was used. I would like to have an explanation of the variations of the card and what should be done to improve operating conditions. W. W.

Which Combustion Chamber is Best?

REGARDING BOILER settings and furnaces, I would like to ask which is considered the best form back of bridge wall. That which drops right down vertically back of bridge, giving one a chance to get around under the rear end of the boiler, or the setting which sometimes starts at the bridge and slopes gradually to the back end; in other cases, it is carried on the same level as the boiler and then drops down at the blowoff to form an ash chamber, the distance being governed by the distance the bridge is located from the boiler. The writer, of course, is referring to h.r.t. boilers. Should like to hear from some of Practical Engineer readers as to which they prefer. N. P.

Automatic Water-Level Regulation; Heater Trouble

IN REPLY to the inquiry of G. I., page 206, of the Feb. 15 issue, as to how he may automatically regulate the level of the water in his boilers, Frank Wells and Receiver recommend the use of automatic governors on the feed pumps and automatic feed regulators on the boilers, suggesting reference to the advertising pages of Practical Engineer for further information relative to such governors and regulators. C. H. Willey, however, mentions only the pump governor, setting forth the facts that these provide the most efficient means for maintaining the water level automatically; require a minimum amount of attention; need not be placed in the boiler drum; are accessible should anything go wrong with them; and may be bypassed during peak loads when full pump capacity is required.

Both Frank Wells and C. H. Willey believe G. I.'s heater trouble may be overcome if he will run a vent pipe from the top of the heater to the atmosphere so as to carry off air which may tend to accumulate in the heater, and promote proper circulation.

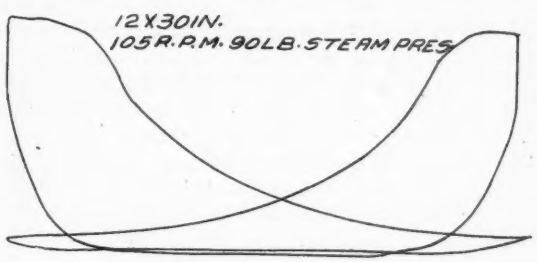
The latter further says: "The oil separation acts as a baffle and should be examined to see that it is intact. Sometimes the pulsation of the engine or machinery exhaust is such that additional means of baffling should be installed. I would suggest that a sketch, together with a description of the heater, its serial number and a diagnosis of the trouble be submitted to the manufacturers, who, I am sure, will give G. I. all assistance possible."

Many times, according to Receiver, when a vacuum exists in a heater and a large amount of water enters in the form of a slug, a noise similar to that resulting from water hammer will be heard. To remedy this, he advises employing a more uniform flow of water and maintaining atmospheric pressure in the heater.

Why the Knock?

THE ACCOMPANYING indicator card was taken from a 12 by 30-in. Lane & Bodly Corliss engine operating under a gage pressure of 90 lb. per sq. in., and at a speed of 105 r.p.m.

At times this engine develops a very hard knock in its head end which may be heard at a considerable distance; at other times it runs perfectly smooth. The duration of these periods is quite variable, sometimes lasting but 3 hr., and at other times continuing for 3 mo. The cylinder is given oil with a force feed pump which keeps it thoroughly lubricated at all times.



CARDS FROM ENGINE THAT KNOCKS

What is the cause of this peculiar behavior? Any suggestions for a remedy tending to eliminate this trouble which some of my fellow engineers may be able to offer will be greatly appreciated. J. A. W.

Boiler Operation Questions

IN REPLY to the question of M. F. T. as to why the tubes of a boiler such as the Heine buckle upward, G. H. Wallace submitted an answer which was published under the above caption on page 133 of the Jan. 15 issue. A. C. M., however, takes exception to the theory advanced by Mr. Wallace and we wish, therefore, that the readers of Practical Engineer would compare the opinions of these two engineers and let us know which of them they uphold. Or, if you have a different view of the subject tell us about it.

Following is the expression of A. C. M.:

Tubes of the Stirling, B. & W. and Heine boilers are all subject to buckling upward. The reason for this is, according to Mr. Wallace, that the tube is sub-

jected to a higher temperature on one side than on the other; but he is mistaken in saying that the upper side is the side subjected to the greatest temperature. The bending action is caused by a deposit of scale on the tubes (bending would likely never occur if the tubes could always be kept perfectly clean), which permits the side of the tube next to the fire to become overheated, while the upper side remains relatively cool, due to the fact that it is protected from the heat radiating from the fuel and does not come into as direct contact with the hot gases as does the lower side. (The soot deposit mentioned by Mr. Wallace also tends to increase the temperature difference.) The results are that the low side, being overheated, tends to expand and increase its length, but is prevented from doing so by its rigid connection to the header or water leg, thus placing it in a state of compression; while the upper side, which is relatively cooler, tends to hold its position, being put in a state of slight tension. The inevitable result of these two forces is the upward bending of the tube which relieves the compression of the lower side. For example, take a bar of rubber 1 in. square and 3 in. long. Stand it on end and apply pressure to one side by placing the tip of the finger on the top near the side farthest from the pressure. If Mr. Wallace's theory was correct, the tubes would bend downward, due to these forces being exerted upon the opposite side, that is, the upper side would be in compression and the lower in tension; or the reverse from the actual conditions.

Mr. Wallace's assertion that cold air entering the firebox during the fire-cleaning periods, etc., causes tube bending, is disproven by the fact that tube bending in water-tube boilers using fuel oil, where the fire doors are bricked up solid, and no chance for quick cooling of the boiler is permitted, is just as prevalent as in coal-fired boilers, and in some cases more, on account of the exceedingly high temperature possible in the oil-burning furnace, which causes scale to form more rapidly. The writer knows of one such case where the lower tubes of a small B. & W. boiler which has carried many heavy overloads, but has never been subjected to any rapid cooling, are bent upward until it is impossible to put a finger between them and the tubes in the next row above. All these tubes show signs of having been overheated on their lower sides. A. C. M.

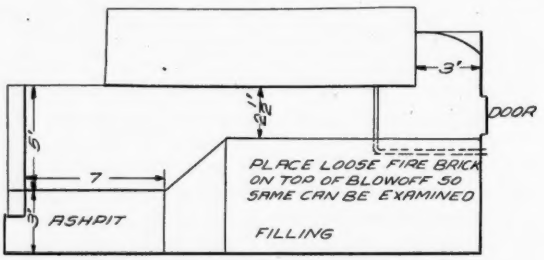
What Setting Construction Would You Advise?

THE ACCOMPANYING sketch I believe may be of some service to E. A. Green in overcoming the difficulties he is experiencing as outlined under the above-mentioned caption on page 247 of the March 1 issue.

Until I made the setting as shown, I also had considerable trouble; the only difference between the case of E. A. Green and mine was that I used wet tan bark for fuel. I discovered that the opening between the top of the bridge wall and the bottom of the boiler shell was too restricted, and also that as soon as the flames passed the bridge wall they would deflect towards the bottom of the combustion chamber. Accordingly, the distance between the top of the bridge wall and the bottom of the boiler shell was increased to 2½ ft. and all the space in the combustion chamber was filled level with the top of the bridge wall. FRANK WOLFLEY.

WHILE the setting shown on page 247 is the latest in furnace construction for this kind of fuel, it appears a trifle out of proportion. The kind of fuel referred to should be fed in a steady stream, directed toward the center of the furnace but should not be touched with any kind of a fire tool; the grates should not be entirely covered, as it is necessary to have free space of from 8 to 12 in. all around the fire for the admission of air.

With the high form of furnace employed, the fuel will tend to pile until there may be 42 in. or more of green dust next to the furnace walls, thus causing smothering of the fires. The first change which I would



SETTING CONSTRUCTION RECOMMENDED BY FRANK WOLFLEY

therefore recommend would be that directing the fuel toward the center of the furnace, allowing the fuel bed to assume the form of an inverted cone.

In calculating the area of the opening over the bridge wall, I find this to be scarcely more than the combined area of the tube openings. I would therefore remove about 10 in. from the top of the bridge wall and raise the combustion chamber floor to this level up to the blowoff pipe pier. Then drop to floor level.

The poorest sawdust for fuel purposes is that from chestnut, cottonwood and white poplar.

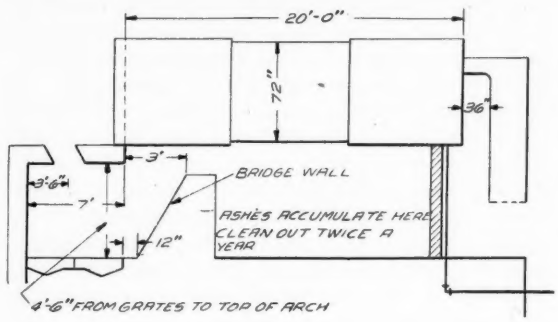
GROVER C. WETHERBEE.

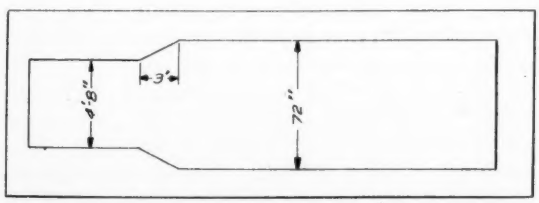
IF I HAD E. A. Green's boiler setting trouble to meet, as outlined on page 247 of the March 1 issue, I would add 50 ft. to the height of the smokestack, cut the length of the grates from 9 to 7 ft., lower the bridge wall 6 in. and after making sure that the setting was air tight, would fire up and let her go.

E. H. SONNEMAN.

HAVING read Mr. Green's question as to why his boilers didn't steam well and having had considerable experience with that type of furnace and variety of fuel, I judge his bridge wall is too high, although it is built according to Hoyle. Also, the back connection is too confined; instead of 24 in., he should have at least 36 to 42 in. between the rear head and brickwork. He speaks of having, perhaps, too much grate surface; this is not the case if he has sufficient fuel to carry a good thick bed on the grates. I would take about 4 in. off the top of the bridge wall, giving 23 sq. ft. space over bridge instead of 20 at present, and increasing space in back connection to 42 in. Would give 26 sq. ft. instead of 15, as at present, which would be more in proportion to the size of the setting. N. W. D.

In the March 1 issue I note the inquiry from E. A. Green regarding his boilers, and I herewith enclose a sketch of 2 20-ft. horizontal return tubular boilers which I am using. The general setting is practically the same, only I note his furnace is 7 ft. 2 in. from grates to arch, where mine are 4 ft. 6 in.; his furnace is 9 ft. long against 7 ft. on mine. As to width of grates, his is 7 ft. 6 in., mine 4 ft. 8 in. We have tried ours several ways, and I think the present setting is as good as anything we have had. At the back of the grate the furnace is sloped or widened out to the width of the boiler, 72 in. in a distance of about 3 ft. (see sketch),





DIMENSIONS OF A SUCCESSFUL SAWDUST FURNACE

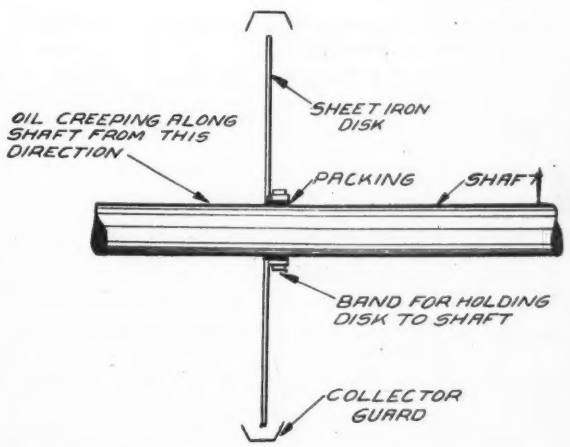
from back end of grates. The distance from bridge to boiler is 27 in. The boiler is 20 ft. long, 72 in. diameter, has 96 3¾-in. tubes and carries 125 lb. pressure. For fuel we have soft wood boxmill waste, white birch, kiln dried shavings, blocks and waste, also an unlimited amount of green frozen white birch, chuck shavings, bark and sawdust. The latter packs down quite hard. We have one feed hole to each furnace, all the dry shavings are automatically fed into furnace from a dust collector system. The boilers are worked hard enough and the setting is fairly good. We use McLeod's Steel Mixture blocks in arch and furnace, firebrick the rest of lining. As is quite prevalent with dutch ovens, they need repairs often. The only suggestion I have to offer E. A. Green is that his furnace is too high and too wide, and perhaps one feed hole in center of grates would help him. On a load around 350 i.hp. our furnaces run very nearly smokeless. N. P.

Oil in the Armature

The trouble F. H. is having with the generator bearing leaking oil is similar to what I had some years ago with a new 100-kw. belt-driven direct-current generator, where the bearing on the pulley side of the generator leaked oil badly and the armature was getting badly soaked with oil. The bearings were of the ring oiling type. I thought at first there was too much oil in the oil reservoir, so I ran the oil as low as possible for a few days, but the same trouble existed. Then the bearing was examined more closely and it was found that the oil came out at the bearing cap joint and was drawn along the shaft and then into the armature by the suction this made.

The joint was made tight by placing a soft fuse wire under the bearing cap joint, then drawing up tight on the cap screens. There was no more trouble from oil leakage. H. A. Jahnke.

F. H.'s question relative to this subject, p. 207, Feb. 15 issue, has been noted with considerable interest, and while the experience I have had does not follow exactly the same line, the idea could probably be used to advantage in his case. We had trouble with a motor-driven water pump because the water would leak through the glands and creep along the shaft into the motor, causing trouble. We overcame this by attaching to the shaft between the pump and motor a tin disk, 14 in. in diameter, fastening it to the shaft by means of packing. The water, being carried along the shaft, reached the disk and being prevented from creeping further, ran out along the surface of the disk until it reached the periphery where, due to centrifugal force, it was thrown



ARRANGEMENT AND METHOD OF MOUNTING DISK AND COLLECTOR

off. To catch the water we built a simple trough around the entire disk as shown in the accompanying sketch.

I believe if F. H. attaches such a disk to his engine shaft, provided, of course, he has the space to do so, it should do away with the trouble he is having. The slower the speed of the engine the greater should be the diameter of the disk, so that a sufficiently high peripheral speed is acquired to throw off the oil which accumulates.

Another suggestion occurs to me, namely, that F. H. might cure the trouble by placing on the shaft a number of loose fitting asbestos rings which would tend to wipe and absorb the oil as it creeps along the shaft, the rings being renewed whenever they become saturated with oil.

M. A. Saller.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH

BY THE TECHNICAL PUBLISHING CO.

537 South Dearborn Street,

CHICAGO, ILL.

New York Office, 150 Nassau St.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Copyright, 1917, by Technical Publishing Co.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

Circulation of this issue, 22,000.

CONTENTS

The Canton Substation. Illustrated....299

Belting. Illustrated....305

Coal and Ashes Handling and Storage—IV. By Henry J. Edsall. Illustrated....308

An Ingenious Load Indicator. Illustrated....310

Water Heating in Closed Tanks. By T. W. Murphy. Illustrated....311

American Institute of Weights and Measures....312

Coal Storage De Luxe. Illustrated....313

Generator Control—II. Illustrated....315

Why He Is a Great Engineer. By N. G. Near....318

Points on Raw Water Can Ice. By V. R. H. Greene....319

Economical Lubrication in Ammonia Compressors. By J. W. Fromeyer....319

Common Salt for Preserving Wood. By Mark Meredith.320

Letters Direct from the Plant: Sparking Collector Ring. Using the Indicator After Accident. Recharging Dry Cells. Improving the Diagram. Pump Troubles Results With Oil as Fuel. Engine Questions Discussed. Guides on Float to Prevent Wear. Making Uptake Doors Tight. First Aid Lockers. Metallic Packing for Pumps. Illustrated....321

Problems for Discussion by Readers: What Is Wrong? Why the Corroded Fittings? Operating Barometric Condensers. Criticism of Diagram Desired. Which Combustion Chamber Is Best? Automatic Water-Seal Regulation; Heater Trouble. Why the Knock? Boiler Operation Questions. What Setting Construction Would You Advise? Oil in the Armature. Illustrated....326

Editorial: Our Country's Need. Editorial Comments...330

Robertson Dry-System Oil Purifier. Illustrated....332

Mechanical Soot Blowers in Oil Burning Boilers....332

Largest Electric Motor Built. Illustrated....333

News Notes....333

Catalog Notes....333

Trade Notes....334

Our Country's Need

As this is written it seems impossible that any turn of events can prevent the United States from being involved in active participation in the great war. We believe that nobody wishes it, but there are limits beyond which we may not recede, if we would retain any sense of national honor; and recent actions, which utterly disregard the safety of our citizens, and which deliberately seek to provoke hostility toward the United States, have overstepped this limit.

If war comes, or has come by the time this reaches Practical Engineer readers, the question comes home to each of us: What should be our attitude in this crisis?

While many who have friends and relatives in the warring countries have felt the personal touch of the awfulness of war, a great part of the people in this country have as yet realized but vaguely the real meaning of war in the life of a country. We have become accustomed to the daily report in the papers of a loss of life which 3 yr. ago would have caused world-wide horror. Written and photographic record of the devastation and suffering in the war-swept lands are as common as reports of crop conditions and fires. But the hardship of war has passed us by, except as it has affected the cost of the necessities of life.

We must, however, prepare ourselves to face the realities, and we can readily see by a study of conditions in England and France what this may mean. What personal sacrifices must we expect to make?

It must be admitted by every candid student that Germany has perfected the most powerful land fighting machine ever known in the history of the earth. If this advantage is to be overcome, it must be by superiority in numbers and resources. What awaits a country conquered and held by an enemy, even if it be eventually reconquered, is found in the reports of conditions in those parts of France recently retaken by the French and British armies. During the occupancy the conquerors will, naturally, live so far as possible, from the resources of the occupied territory, and will deplete those resources regardless of the results; and if forced to evacuate, they will leave behind them, as nearly as possible, a barren waste. That is *war*, and must be expected.

It is, therefore, vital that we take every possible precaution to prevent the occupation of any portion of our territory by an enemy. This may seem like a visionary and needless anticipation, but the danger on our southern border is not to be forgotten, and the easy possibility of an invasion from across the ocean in case an enemy should by any chance gain freedom of the seas for its transports has been clearly demonstrated by our naval and military experts.

We must, therefore, face the fact that a large army will be required, and must prepare ourselves to go and to give up our sons and brothers in great numbers to form this army. And we must stand ready to pay the cost in taxes and sacrifice of comfort.

Probably, almost certainly, our navy will be involved in actual fighting. The men and the means must be provided, and the suspense borne of waiting to hear what successes or failures may come, and who have paid with their lives for our peace and security.

And for those who remain to keep up the country's

industries and to furnish the equipment and supplies needed, there is as great honor in doing one's full duty as in going to the front, even if it is not rewarded with popular acclaim. Private gain must be sacrificed to public welfare; leisure and comfort must give way to strenuous work and endurance, and the spirit of helpfulness for those on whom the severe conditions work extra hardship must be fostered.

Examples are not wanting of loyal and patriotic preparation. Copper makers have offered of their product such supply as the government may need at half the market price; many steel mills and industrial plants are preparing to help, regardless of the interference with normal business; Mr. Ford has offered his great plant at Detroit for government use, to be operated without profit. While few are in position to be of such immediate and far-reaching assistance, each one can adopt the spirit of helpfulness and readiness to do his bit, whatever it may be.

Whether we agree with our leaders or not—whether we can see the outcome or not—the present is a crisis that calls for united action. Somebody must be responsible, and the people have chosen who shall lead. It is now for us to stand behind those leaders and our country whole-heartedly and to the limit of our ability; to give our utmost of loyalty, service and sacrifice for this land of ours.

Editorial Comments

THE CANTON SUBSTATION of the American Gas & Electric Co. is of a type that has proved successful in long distance transmission systems of the West and South where water power is the source of energy. The outdoor construction for high tension stations has been developed within the past 10 years, and due partially to this construction transmission voltages have jumped from 66,000 (that of the Niagara development 20 years ago) to 130,000 today. During this time many details in the design of such apparatus as lightning arresters, high tension switches, transformers, remote control apparatus, synchronous condensers, insulating materials, etc., have been perfected and investigators have brought out phenomena which make themselves apparent only at these extreme high voltages. Such undertakings as the Windsor-Canton development widens the field of the steam power plant and men in charge of such plants should not overlook the opportunities opened up to them by the electrical engineers of the country who have made wide distribution of power possible.

BELTING, though one of the oldest methods of transmitting power, still has a field apparently all to itself and a study of its manufacture and use will benefit anybody in the power plant who has not already become familiar with the subject. The article in this issue under the above heading is the first of a series written to aid those who have, or expect to have, charge of belts; familiarity with the methods of splicing, even, may save your plant many hours of shut down while waiting for an expert belt splicer.

COAL AND ASHES HANDLING AND STORAGE permits the exercise of considerable ingenuity in the selection of equipment and arrangement of apparatus. In this issue Mr. Edsall describes plants where the locomotive crane is called into service for inloading and reclaiming coal held in storage. This equipment may be used in many places where other systems would be too expensive and its advantages should be investigated before installing a coal handling system.

AN INGENIOUS LOAD INDICATOR, as described in this issue, has advantages which can well be appreciated by the force in charge of operation. It is a simple device, easily made and the principles employed are applicable, in some way, to nearly all types of engines. What kind of an indicator do you have to aid your firemen?

COAL STORAGE DE LUXE is by no means an inappropriate heading for the article describing the coal handling system at the Lake View Pumping Station. There is positively nothing about the plant to which the fastidious residents in the neighborhood can object.

GENERATOR CONTROL is one of the secrets to the success of electric power and the automatic regulation of voltage requires rather complicated devices, as shown in the second article of the series upon this subject which is published in this issue. An understanding of these devices is, however, essential to the operation of a large plant.

ECONOMICAL LUBRICATION IN AMMONIA COMPRESSORS is an entirely different problem from that of ordinary steam engines, due to the use made of the condensed steam. Mr. Fromeyer discusses the problem from a practical standpoint and illustrates his points with examples.

COMMON SALT FOR PRESERVING WOOD, well why not? We use it for preserving meats and vegetables. But for wood it is something new and, we are told, exceptionally good. Many of the greatest discoveries deal with the most common commodities.

LETTERS DIRECT FROM THE PLANT which have been selected for publication in this issue will appeal to many because of the direct use that can be made of the information contained in them. These, however, deserve particular attention: Using the Indicator after Accidents, Results with Oil as Fuel, and Metallic Packing for Pumps. They are worth your while.

Warning

ENGINEERS in the southwest are cautioned against giving any subscriptions for magazines to a man signing himself H. L. Neuman, or otherwise, and carrying blanks of the "Chicago Magazine Circulation Bureau." There is no such firm in Chicago and this man is a swindler. He is of small stature, about 25 yr. old, smooth shaven and weight about 135 lb. His operations have been reported from Ft. Worth and Waco, Texas, and other southwestern cities. Do not pay any money for Practical Engineer to anybody unless he is personally known to you, or else carries proper credentials signed by Arthur L. Rice, Editor, and has subscription blanks addressed to Practical Engineer or Technical Publishing Co., on which he gives you a proper receipt for the money.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Robertson Dry-System Oil Purifier

HEAT alone is employed as the precipitating medium in the purification of oil with the Robertson dry-system oil purifier, which is so constructed with doors in front of the tray chamber, and at the side of the filtering compartment, that the interior may be directly accessible for the inspection and regulation of the oil flow or removal of trays, or for the inspection or replacement of the filter bags.

Incoming oil from the bearings to this purifier first passes through a strainer where the heavy impurities are collected, the oil then passing down through a stand pipe to almost the bottom of the settling chamber. During this passage it is being heat treated and does not come in contact with the partly purified oil in the rest of the chamber until the sediment and condensation is deposited in the bottom, the lighter oil in rising passes

VERTICAL TYPE OF ROBERTSON OIL PURIFIER

through a pipe leading to the trays. Surrounding each tray is an individual steam jacket which is piped to carry off all condensation.

Upon passing into the trays, the oil receives an additional heat treatment in each compartment and flows over the baffles in a tortuous course until it reaches the filter bags, the bags being employed merely to collect particles too light to deposit, such as floating mica and graphite. The oil then flows into the clean oil chamber located in the bottom of the purifier where it is cooled by water circulating through a pipe coil, the purified oil then being drawn through a suction pipe located beneath the cold water pipe coil and pumped to an overhead tank or direct to the bearings as desired.

Each tray of this purifier, which is manufactured by the John F. Robertson Co., of Pittsburgh, Pa., operates independently of the other trays and may be cleaned separately while the others are filtering.

Mechanical Soot Blowers in Oil Burning Boilers

TODAY there is an efficient soot blower system to meet the requirements of every type of boiler, economizer or incinerator, and development of the mechanical soot blower for oil burning boilers to a point of perfection has been attained by the efforts of the engineering staff of the Diamond Power Specialty Co., of Detroit.

The coating that accumulates on the tubes of an oil burning boiler is real soot or lamp black, a sticky, gummy substance which clings with great tenacity to the tubes. Jets of steam issuing from the special Venturi nozzles of the Diamond soot blower system at a velocity of approximately 2795 ft. per sec. thoroughly remove this soot from the heating surfaces and thereby permit a natural transference of heat to the water in the tubes.

The use of the Diamond soot blower effected a saving in oil fuel of 3.9 per cent by actual test for the Pacific Gas & Electric Co., as shown by report made by the superintendent of power for that company.

"The following is a report of the efficiency of the Diamond soot blowing apparatus that is installed in the 2 822-hp. Stirling boilers at Station A. The installation on each boiler has 6 revolving units, one at the top and one at the bottom of each pass. Each unit consists of a 2-in. pipe extending the entire width of the boiler, with special Venturi nozzles spaced between the lines of tubes.

"The pipe is revolved by means of a chain wheel on the boiler side, thus blowing the steam between the tubes. When blowing tubes, the path of the furnace gases is followed and the dampers opened wide to allow the soot to be carried out.

"As is seen in the following test results, the temperature of the gases in the stack were decreased 69.25 deg. F., and the temperature of the superheated steam increased 0.6 per cent by dusting the tubes. Calling the efficiency of the boilers 70 per cent, this means a saving of 3.9 per cent that is effected by dusting."

TEST DATA BEFORE BLOWING

Time	Temperatures Deg. F.		Load
A.M.	Stack	Sup. Steam	Meter
10:15	550	500	4.2
10:30	550	502	4.0
10:45	555	498	4.0
11:00	557	498	4.1

TEST DATA AFTER BLOWING

P.M.			
2:30	485	495	4.2
2:45	485	506	4.0
3:00	482	504	4.3
3:15	483	505	4.2

TEST RESULTS

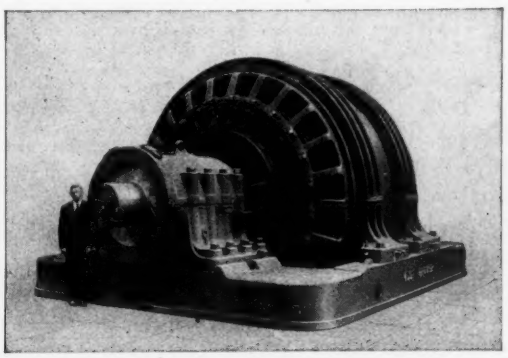
	Before using Soot Blowers	After operating Soot Blowers
Load meter	4.075	4.175
Per cent rating.....	101.88	104.38
Steam pressure gage, lb..	199.5	200.75
Superheated steam temp., deg. F.	499.5	502.5
Stack temp., deg. F.....	533	483.75

These results show that the operation of the Diamond soot blowers caused the temperature of the stack gases to fall from 553 deg. F. (290 C.) to 483.75 deg. F. (252 C.), making a difference of 62.25 deg. F., or 13.05 per cent.

Also the temperature of the superheated steam was raised from 499.5 deg. F. (260 C.) to 502.5 deg. F. (262 C.), a rise of 3 deg. F., or 0.6 per cent.

Largest Electric Motor Built

IN THE accompanying illustration is shown a 15,000-hp. electric motor, said to be the largest ever constructed. This machine, which is of the reversing type, was designed and built by the Westinghouse Electric and Manufacturing Co. for driving 35-in. reversing blooming mills in steel plants.



FIFTEEN THOUSAND-HORSEPOWER WESTINGHOUSE ELECTRIC MOTOR

Some idea of its size may be gained from the fact that the man standing alongside of the motor is 6 ft. tall.

News Notes

THE OFFICES of The Chapman Valve Mfg. Co., at Indian Orchard, received, March 5, a cable from their representative at Buenos Aires advising that they had been awarded a contract for supplying valves to the Obras Sanitarias de la Nacion, a Department of the Argentine Government, amounting to $237,000, the valves to be used in constructing water works plants throughout Argentina. Heretofore, the valves for this work have been purchased largely in England and Germany. This is the largest single order or contract for valves ever placed in this country by any South American country and follows an order received by the same representative last October for 66,000 tons of cast-iron pipe for the United States Cast Iron Pipe & Foundry Co.; the pipe order amounted to $3,500,000.

In October, 1915, the Chapman Company and the United States Cast Iron Pipe & Foundry Co. joined in the expense of sending a representative to South America, and these contracts are the results of the work of this representative backed by the reputation and ability of both companies.

ADDITIONS have been made to the organization of Walter B. Snow & Staff, of the following men: Frank C. Thomas, who has been in the advertising department of the Cadillac Motor Car Co., also manager of the Cleveland office of J. Walter Thompson Co., and in the advertising department of Hardware Age; Clarence C. Jones, formerly manager of System's Advertising Service Bureau, and of the Greenleaf Co., and Chas. W. North, formerly manager of the art department of Iron Age and Hardware Age.

CONSOLIDATION is announced of the publishing interests of International Trade Press, Inc., and Electrical Review Publishing Co., Inc. The combined company will continue publication of Cement World, International Trade, Index of Current Technical Literature, Electrical Review and Western Electrician, and the Electrical Blue Book. Officers of the new organization will be C. A. Tupper, president; Chas. W. Price, vice-president; Lyman A. Sisley, secretary-treasurer; A. A. Gray, general manager..

GEORGE L. HAMMONS, for 18 yr. vice-president and treasurer of the Advance Packing & Supply Co., of Chicago, has sold his interest in that concern and has formed the corporation of George L. Hammons, Inc. With him will be associated J. G. Ross and W. L. Griffin, also formerly with the Advance Co., the office and salesrooms being recently opened at 627 W. Washington Blvd., to furnish engineers' supplies, factory equipment, specialties for the engine room and asbestos goods.

IN ORDER to take care of the increased demand for gas meters, pressure and draft recorders, CO_2 indicator, therometers, etc., the Bacharach Industrial Instrument Co. has moved into larger quarters at 422 First Ave., Pittsburgh, Pa. The enlarged space, together with additional equipment, will enable the company to take care of the increasing business to the fullest satisfaction of its customers.

Catalog Notes

THE INGERSOLL-RAND CO., 11 Broadway, New York City, has recently issued two new catalogs on Dry Vacuum Pumps, Form No. 3037, covering the straight line type and Form 3038 on the duplex type. Both machines are equipped with "Ingersoll-Rogler" valves, are capable of maintaining a high vacuum and will handle discharge pressures of several pounds. The maximum degree of vacuum possible varies with the different machines, to within 0.6 in. of the barometer.

Steam and power driven types of pumps are listed in a large range of sizes and capacities in the catalogs, which are profusely illustrated in colors to show the machines in whole and in section. Copies will be mailed free on request to the nearest branch office.

BULLETIN O-2 of The Lagonda Manufacturing Co., Springfield, O., which has just been received, contains complete description of Lagonda air, steam and electric driven cleaners for cleaning the small tubes of condensers, heaters, evaporators and similar apparatus. Graphic illustrations show the existing relationship between the vacuum and steam consumption, and views are shown of Lagonda condenser cleaners at work in different types of condensers in power plants and ice plants. A special cleaner for evaporator tubes is also described. The company will be pleased to send the bulletin to any reader who is interested.

AUTOMATIC STARTERS for squirrel cage induction motors are described and illustrated in deseriptive leaflet No. 1660, just issued by the Westinghouse Electric & Mfg. Co. These starters are used with single-phase and poly-phase squirrel cage induction motors of all commercial ratings where it is desired to start from a remote point and where automatic acceleration is necessary on account of unskilled operators.

The construction details are given in full and illustrations of component parts are shown.

ATHOL AND STARRETT vises, machinery and fine tools are illustrated and price lists are given in a new 60-page catalog, No. 32, from Athol Machine Co., Athol, Mass.

Trade Notes

SARCO COMPANY, INC. (steam traps and temperature regulators), of Woolworth Building, New York, has added Buffalo to its list of branch offices. The new office is located at 325 Ellicott Square, and is under the charge of F. D. Harger.

AMONG THE more recent orders received by the Westinghouse Machine Co., of East Pittsburgh, Pa., for complete equipments of turbines, gears, and condensing apparatus for ships now in construction, are the following: Chester Shipbuilding Co., 1 2500-s.hp. set; Skinner & Eddy Corporation; 1 2500-s.hp. set; Ames Shipbuilding & Dry Dock Co., 3 2500-s.hp. sets; Baltimore Dry Docks & Shipbuilding Co., 2 1800-s.hp. sets; Moor & Scott Iron Works, 3 2500-s.hp. sets, including turbines and gears.

HOMESTEAD VALVE MANUFACTURING CO., of Homestead, Pa., announces the appointment of the following representatives to have exclusive representation of the Homestead quarter-turn cock and the Hovalco angle blowoff valve in their immediate vicinities: Queen City Supply Co., Cincinnati, Ohio; Root, Neal & Co., Buffalo, N. Y. These representatives carry a large stock of Homestead valves on hand at all times, and are in a position to quote on all lines of Homestead manufacture.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH.

SEMI-MONTHLY

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.

In Canada, subscription price, $1.75 a year.

Foreign Countries, subscription price, $2.50 a year.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago. Ill.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES
Display

Full page, one year, each insertion, $66.00.

Half page, one year, each insertion, $38.50.

Quarter page, one year, each insertion, $22.00.

Eighth page, one year, each insertion, $13.25.

Front cover, $175.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,000.

Technical Publishing Co.

537 S. Dearborn Street

Chicago.

Position Wanted

POSITION WANTED—I am a thoroughly competent power plant engineer, accustomed to handling on high efficiency basis all types of steam engines and turbines, a.c. and d.c. machines; strictly sober; 34 years old, married. Want charge of good plant in Chicago that will pay at least $25.00 per week. Address Box 455, Practical Engineer, 537 S. Dearborn St., Chicago. 3-15-1

POSITION WANTED—As chief or first operating engineer by experienced and reliable power plant engineer, at present employed in one of the largest power houses in Northern Illinois; can furnish best of references; good reasons for changing. Address Box 476, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

POSITION WANTED—By man, 30 years old, good habits, married, with 6 years' experience in steam electric plants. Would like position as engineer in plant of 2500 k.w. capacity or more, where I can advance myself. Address Box 471 Pracical Engineer, 537 S. Dearborn St., Chicago, Illinois. 3-15-1

POSITION WANTED—Young man wishes position as oiler or assistant engineer in a plant in New York City. Two years' practical experience. Write William Brand, 24 Locust Hill Ave., Yonkers, N. Y. 4-1-1

POSITION WANTED—Young man, age 28, as engineer in New York or Brooklyn. Hold marine, stationary and refrigeration license. Day work, 8-10 hours, desires to go to school nights. Write for particulars. Box 452, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 4-1-1

POSITION WANTED—As oiler, by young man, age 21, single. Willing to accept position in any city. Address Peter Stanys, 670 W. 18th St., Chicago, Ill. 4-1-1

CHIEF ENGINEER wishes to relocate. Now in charge of 15,000 k.w. railway plant. Eight years' experience operating turbines, engines, tubular boilers, with stokers, direct and alternating current generators, also refrigerating machines. Best of references. E. D. D., 1517 Military Ave., Omaha, Nebr. 3-15-1

STEAMFITTER—Accustomed to high pressure work wants permanent situation. American and strictly sober always; am not afraid of plenty of work. Can work from blue prints, as well as do all kinds of general repairs. Have some experience in millwright work and some knowledge of steam engineering. H. L. Simonds, Box 166, Sac City, Iowa. 3-15-1

POSITION WANTED—As Fireman or Oiler in large plant; 3 years, experience as fireman, 18 months as assistant engineer. Married. Strictly sober. Prefer Southern States. L. C. Drake, Cambridge City, Ind. 3-15-2

POSITION WANTED—As chief engineer in industrial plant, Missouri, Arkansas, Kansas, Iowa or Nebraska, or as Superintendent of light and water plant in city of 2500 to 8000. Ten years' practical experience with steam, electrical and water systems. Technical training. Now employed by U. S. Government as engineer and instructor. Executive ability. Can report on 15 to 30 days' notice. Married. Age 30. Address Practical Engineer, Box 466, 537 S. Dearborn St., Chicago, Ill. 4-1-1

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Cal. Washington, D. C. This is an excellent chance for a hustler who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—A first-class fireman to look after twelve 150-hp. tubular boilers; one who is well up in economy in coal and understands thoroughly the care of boilers; must be sober, industrious and steady. A good position for the right man. Address Practical Engineer, Box 469, 537 S. Dearborn St., Chicago, Ill. 2-15-3

TECHNICAL MEN are wanted for Federal Civil Service. We coach by correspondence for many of these examinations. Write for free booklet QF 875. Washington Civil Service School, Washington, D. C. 4-1-1

Wanted

WANTED—Agents on commission to sell our shaking grates. We will install grates on trial or put it to test at our expense with any grate made. Address Armstrong Mfg. Co., Springfield, Ohio. tf.

FOUR COPIES of Practical Engineer for February, 1910, in good condition; will extend your subscription for three months. Circulation Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

WANTED to purchase one secondhand alternator, 75 or 85 k.v.a., 60 cycle, 3 phase, 2300 to 2400 volts, 900 r.p.m. belted type, rev. field machine, with exciter and other accessories. Guaranteed to be in first-class operating condition. Send copy of name plate with quotation. H. E. Johnson, Supt., Senatobia Electric Light & Water Plant, Senatobia, Miss. 3-15-2

WANTED—Agents handling engine and boiler room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Box 381, Practical Engineer, 537 S. Dearborn St., Chicago, Illinois. tf.

WANTED—Experienced salesmen, strictly commission basis, for the most efficient feed water heater and purifier on the market. State former connection, experience and territory covered. Moffat Feed Water Heater & Purifier Co., Dayton, Ohio. 4-1-2

For Sale

For SALE, in North Dakota town of 1000 population, electric light and power plant. Twenty-four-hour service. Plant in good condition. Distribution system covers entire town. Extensions well cared for. Good feed mill business in connection. Price, $30,000. Terms, one-third cash, balance to suit at 5 per cent interest. Address Box 474, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 3-15-4

FOR SALE—McKenzie chain grate stoker, practically new. Address A. P., 517 Monadnock Bldg., Chicago, Ill. 3-1-3

Patent and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. High references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN, Patent Lawyer, 624 F St., N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact costs. Send for full information. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.

PATENTS — Send sketch for free search and reports. Books and patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Technical Books

FREE ENGINEER BOOKS and power plant tools and specialties, for securing new subscribers for Practical Engineer. A dandy chance for the engineer with a little spare time, to get some fine premiums. Send for free descriptive circular and terms. Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes without back pressure on your engine? If so, address Monash Engineering Co., 1413 Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

Advertising the Public Libraries

Again does Advertising come to the front for something more than a pecuniary reason. This time it is fostering the movement to awaken interest in the public libraries of the nation.

It is a regrettable fact that many of the really worth-while books of the library are rarely lifted from the shelves. Books that would have made Abraham Lincoln leap for joy are never thought of by the present generation. Whatever this is due to it is a condition to be regretted, especially when it is considered that the books are loaned absolutely free. It is not necessary to put in a full day at laborious work for the loan of a book, as did Abraham Lincoln.

Our present indifference to the value of the libraries may be due to a misconception of the 8-hour work—8-hour play—8-hour sleep program of the average individual. Surely part of the 8 hours play can be used for the reading of some good book. It is recreative and is a kind of play anyway. Engineers have a craving for engineering literature and any time spent in reading it is time well enjoyed.

This is a commercial era and the two things which seem uppermost are the pursuit of gold and the pursuit of pleasure. The multitudes neglect the cultural side of life. Only some of the elite have given consideration to this, and they have interspersed it so much with the social and the faddish that theirs is a pot-pourri of all, with the balance registering on the social side.

Perhaps the neglect of the multitudes in using the libraries is due to the absence of the open fireplace and the family circle where any subject conducive to open discussion was brought before the house, or where brother, in stentorian tones, and to the tune of the cracking log, would read The Midnight Ride of Paul Revere to his small audience of receptive-minded people.

The object of this library advertising is to make the public library a popular institution—to let every person know that the books he wants are waiting for his use. It is the prediction of the writer that some day laboratories will be installed in connection with well organized reading courses.

Engineers use their copies of Practical Engineer as a reference library, and their power plant as the laboratory.

They also keep some books but it must be remembered that no private library can be as complete as the public library. It is well then to back up the study of Practical Engineer and the books in the engineer's own library with the loaning of books from the public library. Advertising will enforce a better method of distribution so that the books will be accessible to all people, not excepting the busy engineer. So, all hail to the public library—all hail to the part Advertising is taking in bringing the book to the man, and the man to the book. And all hail to the Chicagoan who conceived the idea of inducing libraries to make known their purpose and their wares.